

**STATUS OF
CENTRE - STATE COORDINATION
IN AGRICULTURAL RESEARCH, EDUCATION & EXTENSION
IN REGION No. VIII**

XXIII Meeting of ICAR Regional Committee No. VIII



**Karnataka
Kerala
Tamil Nadu
Union Territories of
Puducherry & Lakshadweep**

**Held at
Coimbatore
June 15 - 16, 2012**



**INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI - 110 001**

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February 2013

**INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI 110001**

Status of Centre State Coordination in Agricultural Research, Education & Extension and
Proceedings of XXIII Meeting of ICAR Regional Committee No. VIII,
June 15 - 16, 2012, Coimbatore.

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शरद पवार
SHARAD PAWAR



सत्यमेव जयते

U.O. No. 81/AM
कृषि एवं खाद्य प्रसंस्करण उद्योग मंत्री
भारत सरकार

MINISTER OF AGRICULTURE &
FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA
10 JAN 2013

MESSAGE

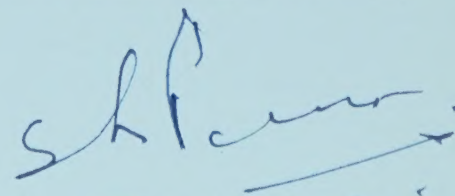
I am happy to learn that the Indian Council of Agricultural Research (ICAR) is bringing out a publication entitled 'Status Report on Centre-State Coordination in Agricultural Research, Education and Extension Region No. VIII' that comprises the states of Karnataka, Kerala and Tamil Nadu, and the union territories of Puducherry and Lakshadweep

The Region VIII is one of most productive regions in the country in terms of production of agricultural/horticultural crops, animal husbandry and fisheries. The ten Agricultural/Horticultural/Veterinary/Fishery Universities, 14 ICAR Institutes and several Regional/ Research Centres of ICAR Institutes in the Region play a pivotal role in resolving the regional as well as national issues leading to a sustainable production system.

The Region with a long coast line, Western and Eastern Ghats, high rainfall and semi-arid areas has enormous biodiversity and rich in flora and fauna which needs to be conserved. The region contributes a lion's share of spices and plantation crops produced in the country. While Kerala is the land of spices, Karnataka excels in the production of horticultural crops. Tamil Nadu produces the highest per hectare yield in several important crops like sugarcane and coconut, besides leading in the poultry production.

Impact of climate change on agriculture will be one of the major factors deciding the future food security in the country. There is an urgent need to improve the resource use efficiency for sustaining the production and productivity in the long run and to conserve the natural resources. Simple, easy to operate tools and farm machinery should be developed to reduce the drudgery and the cost of cultivation. Cost effective and environmentally friendly control measures are needed for major diseases and pests. In order to ensure food and nutritional security to the ever growing population and to meet future needs of food, feed, fodder and raw materials for agro based industries like textiles and sugar industry, the R and D organizations have to aim at not only sustaining but also increasing the productivity.

In this context, the ICAR Regional Committees provide an ideal forum for dialogue amongst research and development agencies in the field of agriculture and allied fields and help in forging an effective liaison and coordination among the various players and stakeholders. I am sure the document will provide a basis for the policy makers, planners, scientists and all those engaged in the task of development of the Region. I congratulate the ICAR for their sincere efforts in this endeavour in espousing the cause of growth and development of agriculture in the Region.


(Sharad Pawar)

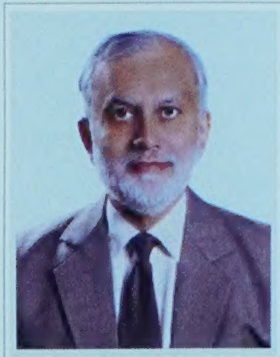


डा. एस. अय्यप्पन

सचिव एवं महानिदेशक

Dr. S. AYYAPPAN

SECRETARY & DIRECTOR GENERAL



भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि मंत्रालय, कृषि भवन, नई दिल्ली 110 001

GOVERNMENT OF INDIA
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FOREWORD

Centre-State relationship is vital for taking forward ICAR technologies to different agro-climatic zones in the country. In this connection, ICAR has set up eight Regional Committees to provide a unique forum for meaningful dialogue amongst researchers, policy makers and development personnel in agriculture and allied fields. The Committees play an important role in identifying and prioritizing the research and development needs of the region and act as an interface between the research organizations and development departments. The Regional Committees meet once in two years to discuss and review the current status of agricultural research, education and extension and to identify gaps in research and technology transfer.

The XXIII Meeting of ICAR Regional Committee, Zone-VIII was held at Coimbatore during 15-16 June 2012. The meeting was inaugurated by Shri S. Damodaran, Honorable Minister for Agriculture, Government of Tamil Nadu. During the two day deliberations, various issues related to Agriculture, Horticulture, Animal Husbandry and Fisheries pertaining to the States / Union territories of the region were highlighted by the officials from the respective Departments. The Vice Chancellors, Directors of Research, Directors of Extension Education and Deans of the five Agricultural Universities, three Veterinary Universities, one Horticultural University and one Fisheries & Ocean Studies University situated in the region responded to the issues flagged by the development departments and also highlighted the achievements of the universities in research, education and extension education. The Deputy Directors General from the ICAR Head Quarters responded to the various issues raised and suggested suitable remedial measures. Directors of ICAR Institutes, Project Coordinators and Heads of ICAR Centres located in the region highlighted the achievements and research needs.

Based on the two day deliberations, fourteen recommendations pertaining to the research and development activities and agricultural education in the region were made. The active participation and meaningful interactions of the participants contributed to the success of the meeting. I thank all the participants for their valuable contributions during the deliberations. I appreciate the efforts of Dr. K. D. Kokate, DDG (Agrl. Extn.) and Dr. N. Vijayan Nair, Director, Sugarcane Breeding Institute, Coimbatore and Member Secretary, ICAR Regional Committee No. VIII for bringing out this Status Report on Central-State coordination in agriculture and allied sectors in the region. I am sure, this publication will serve as a useful document in the strategic planning of research and development activities for the overall development of the region.

(S. AYYAPPAN)

Dated the 9th January, 2013
New Delhi



ACKNOWLEDGEMENTS

I express my sincere thanks and gratitude to Shri S. Damodaran, Honorable Minister for Agriculture, Government of Tamil Nadu for inaugurating the XXIII meeting of the ICAR Regional Committee No. VIII and for flagging several issues which need urgent attention and for his valuable suggestions for improving the agricultural sector in the State.

I am extremely grateful to Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR under whose stewardship this meeting was organized, for his constant support and guidance for the successful and smooth conduct of the meeting.

It is with immense pleasure that I thank Dr. K.D. Kokate, Deputy Director General (Extension), ICAR and DDG in charge of Regional Committee No. VIII for his constant support, able guidance and encouragement.

I wish to record my sincere thanks to the Vice Chancellors, Deans, Directors of Research and Directors of Extension of the State Agricultural / Horticultural / Animal Sciences / Fisheries universities located in the states of Tamil Nadu, Karnataka and Kerala for the active participation, keen interest, effective interventions and useful suggestions regarding the problems confronting the region.

I express my sincere thanks to the Deputy Directors General, National Director (NAIP), Assistant Directors General, Directors of ICAR Institutes, Project Coordinators, Heads of Regional / Research Centres of ICAR Institutes and other dignitaries for their participation and valuable contributions. The contributions of the officials of the Departments of Agriculture, Animal Husbandry, Horticulture and Fisheries of different states / UTs in the region are gratefully acknowledged.

I wish to record my sincere thanks to Dr. V.V. Sadamate, Advisor (Agriculture), Planning Commission for his participation and interaction. I am also grateful to Shri Sudhir K Bhargava, Member, ICAR Governing Body for his active participation and suggestions for tackling the various issues related to agricultural development in the region.

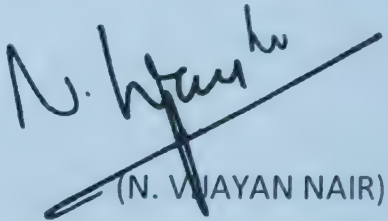
I place on record my sincere thanks to Dr. Ravindra Kumar, Asst. Director General (TC), ICAR, New Delhi for his constant support and advice.

I am very much thankful to Dr. P. Murugesu Boopathi, former Vice Chancellor of TNAU, Coimbatore for extending his whole hearted support and doing the initial spade work for organizing the meeting. I am extremely thankful to Dr. P. Subbian, Registrar and Acting Vice Chancellor, Dr. A. Chandrasekaran, Director of Research, Dr. P. Kalaiselvan, Director of Extension Education, Deans, Directors, Estate Officer and other staff of TNAU, Coimbatore who had extended their wholehearted support and offered all facilities available at the University for holding the meeting. But for their help, it would not have been possible to conduct the meeting successfully.

The logistical support provided by Dr. S. Prabhu Kumar, Zonal Project Director, Zone VIII, Bangalore in organizing the meeting is gratefully acknowledged.

Dr. E.I. Jonathan, Director, Centre for Plant Protection Studies, TNAU has helped in arranging the working lunch and refreshments during the meeting. I wish to acknowledge and place on record the sincere help and support extended by Dr. Jonathan and other University Officers.

My colleagues from Sugarcane Breeding Institute Dr. P. Gopalasundaram, Dr. C. Palaniswami, Dr. C. Sankaranarayanan, Dr. J. Srikanth, Dr K. Hari, Dr. P. Govindaraj, Dr A. Bhaskaran, Dr Rajula Shanthi Dr. D. Puthira Pratap, Shri K.K. Hamza, Dr. N.Thiraviam, Shri Y. Somasekhara Goud, Dr. S. D. Chanrasekaran, Smt. R. Lalitha Rani, Shri Edwin W. Devakumar, Shri R. Palanisamy, Shri M. Kanniayan, members of different committees and others had worked tirelessly for the successful and smooth conduct of the meeting. I appreciate and acknowledge their sincere and hard work. Finally I wish to place on record the efforts of Dr. P. Gopalasundaram, Principal Scientist (Agronomy) Sugarcane Breeding Institute, Coimbatore for his help in preparing this Status Report.



(N. V. NAIK)

Director, Sugarcane Breeding Institute &
Member Secretary, ICAR Regional Committee No. VIII

EXECUTIVE SUMMARY

The XXIII meeting of ICAR Regional Committee No. VIII was held at Tamil Nadu Agricultural University (TNAU), Coimbatore during 15th & 16th June 2012. The meeting was attended by the Vice Chancellors and Officers of the SAUs; Officials of line departments; Deputy and Assistant Directors General from ICAR; and Directors, Project Coordinators, Heads of Regional / Research Centres of ICAR Institutes located in the region.

Inaugural Session

The inaugural Function was held in the Anna Auditorium of TNAU. Dr. P. Subbian, Registrar and Acting Vice Chancellor, TNAU welcomed the participants. Dr. K.D. Kokate, DDG (Agril. Extension) In his Introductory Remarks, explained about the role of Regional Committees in identifying location specific problems and preparing a regional plan for development. In his Presidential Address, Dr. S. Ayyappan, Secretary, DARE & Director General, ICAR outlined the major initiatives taken up during the XI Plan in different sectors which include the NICRA project, Pulses demonstrations etc. He also mentioned that there is an urgent need to strengthen farm mechanization to keep agriculture profitable and sustainable. During XII Plan, focus will be on dry land agriculture, highland agriculture, disaster management, agro tourism / eco-tourism, disease management and climate resilient agriculture.

Shri S. Damodaran, Honorable Minister for Agriculture, Tamil Nadu released six publications, one educational CD, one video documentary and one product from SAUs and Institutes during the occasion. The Hon'ble Minister in his Inaugural Address said that over 90% of the farmers are marginal and small farmers and the research efforts should address their problems. Agricultural education should focus on imparting practical knowledge and providing skills besides entrepreneurship development. He also highlighted the need for crop planning based on market intelligence to ensure good returns and for reducing post-harvest losses. Research Institutions should develop cost effective and user friendly machines that can save labour. The Minister expressed his serious concern over the depletion of water resources and urged the scientists to develop water saving technologies.

Dr. N.V.Nair, Director, Sugarcane Breeding Institute, Coimbatore & Member Secretary, ICAR Regional Committee No. VIII proposed a vote of thanks.

Technical Session

The Technical Session held under the chairmanship of Dr. S. Ayyappan in the Seminar Hall I of TNAU started with a brief self-introduction by the participants. Thereafter, Shri Ullas Menon, Secretary General, UPASI for gave an overview of the plantation crops scenario in the region. The cost of production has gone up. Labour cost and availability being a serious issue, there is an urgent need for mechanization. Unless there is significant improvement in mechanization, the cultivation of plantation crops cannot be sustained. He also mentioned about the Gadgil Committee's Report on Western Ghats ecology recommending that the pesticide application in the Zone has to be stopped gradually, which could have a serious impact on plantation crops. The Chairman informed that tea, coffee, rubber and silk are not dealt by ICAR directly, but there could be collaboration in dealing with the problems.

As per the suggestion of the Chairman, the Action Taken Report on the recommendations of the 22nd RC meeting was approved after discussions.

The Chairman invited the views of the various State departments on developmental issues. Shri M.G. Mohammed Iqbal, Deputy Director of Agriculture, Coimbatore informed that the Department of Agriculture, Tamil Nadu is recommending only the varieties released by TNAU. It was pointed out that some of the private sector varieties are doing better and the SAUs / Institutes have to take cognizance of this.

Dr. Narayana Gowda, Vice Chancellor, UAS, Bangalore said that agriculture is facing a serious crisis on account of low profitability. Integrated farming approaches are recommended to make agriculture more profitable and viable. In Karnataka, training is imparted to farmers on market intelligence and other customized services. Areca Yellow Leaf Disease (YLD) is affecting the areca plantations in the State. Dr. G.V. Thomas, Director, CPCRI responded that an integrated package is available for sustaining the yield of affected palms and resistant palms are now available. The forum felt that apart from the planting material, there should be emphasis on deriving management solutions to take care of the affected plantations. The Chairman suggested that the package on management of Areca YLD evolved by UAS, Bangalore may be evaluated at a few locations and suggested formation of a Committee to look into the issues of Coconut wilt and Arecanut YLD and prepare a Status Report on the two diseases with Dr. G.V. Thomas as the coordinator. To a query by the Chairman, it was informed that 123 Taluks had been affected by drought in Karnataka due to delay in the onset of monsoon. In this context, the Chairman suggested that short duration varieties of crops have to be considered. It was informed that the hybrid rice developed by UAS, Bangalore is likely to make an impact on rice productivity.

Area, productivity and production of minor millets are coming down in the in Karnataka state. These crops have a great future in the view of their hardiness, high nutritional value and ability to withstand climate change. There is a need for further research on all aspects of minor millets production and value addition. It was also felt that there is an urgent need to enhance seed production in minor millets. To a query from the Chairman, it was informed that a sizeable collection of minor millets is available in TNAU gene bank. It was suggested that the Gene Bank information held by TNAU may be shared with the SAUs / Institutes. UAS, Dharwad is promoting the cultivation of minor millets in a big way. It was suggested that the AICRP Centre at UAS, Dharwad may be upgraded to a regular centre. It was informed that salinity and alkalinity are major problems in North Karnataka. UAS, Dharwad has taken up reclamation efforts through its RKVY programme. Water use associations have been formed to impart training on the judicious use of available water.

The issue of rust in soybean and sunflower in North Karnataka was flagged by UAS, Dharwad. Maize area is expanding, but research efforts are limited. The Chairman suggested that RKVY funds could be channelized to equip the centres to address these issues. The Chairman also suggested a target of 10 lakh tonnes of pigeon pea and chick pea for the region.

Dr. Sadamate, Advisor (Agriculture), Planning Commission felt that there should be a relook into the strategy for cotton, especially whether the hybrid cotton could be sustained in view of the popularity of Bt cotton. It was informed that there is good demand for colour cotton but contamination with conventional white cotton apart its techno economic feasibility are major

problems. Shri Bhargava, GB member, ICAR society, felt that the public sector should have been more proactive in the case of transgenic research and the Bt gene could have been purchased from Monsanto. Dr. Sadamate also suggested preparation of soil maps to facilitate identification of the most suited crops.

Regarding the fodder situation in Karnataka, it was informed that UAS, Dharwad has been producing significant quantities of fodder seed / planting material. IGFR has released suitable fodder varieties for all three southern States. It was felt that the required quantities of planting material of fodder could be produced only in a decentralized way through KVKs and Regional Stations of SAUs. Dr. Prasad, Director, NIANP felt that the responsibility for fodder production essentially rests with the State Departments with ICAR & SAUs providing technological backstopping. The Cumbu Napier hybrid CO 4 developed by TNAU can yield 450 t of green matter/ha/year and is now grown in more than 40,000 ha. There was also a suggestion that whenever a variety is released, not only grain quality but straw quality also has to be considered. Establishment of Community Fodder Bank also was suggested to meet the fodder shortage.

IIHR has released several varieties and hybrids of horticultural crops and also developed several other technologies. Shri Bhargava opined that now farmers are prepared to pay higher seed price provided they will get higher yield and thereby higher income. Dr. Naik expressed concern over the inclusion of unapproved plant protection chemicals in the package of practices by different Universities.

Dr. Dandin, Vice Chancellor, UHS, Bagalkot informed that the university has improved the production of the planting materials. Grape production during the year was good, but onion farmers suffered losses due to lack of adequate storage facilities. It was also informed that climate change has affected mango production in the state. The flowering time and fruiting pattern has been affected and there is a need for basic studies on reproductive biology of mango.

Dr. Patil, Vice Chancellor, UAS, Raichur informed that the University has taken a major initiative of training engineering students to start their own service centres. A multi thresher for bajra and sorghum etc. has been developed using a cycle. The Chairman suggested that the equipments developed by ICAR and SAUs may be tested, categorized and circulated among all KVKs. Under XII Plan, priority would be given for renewable energy sources, water conservation and waste management. UAS, Raichur has successfully implemented transplanting of red grams and Shri Bhargava suggested that this technology should be given wide publicity.

Dr. Honnappagol, Vice Chancellor, KVAFSU informed that a new Institute for wild life veterinary medicine has been started in Coorg and M. V. Sc. course in wild life medicine is being offered now. A Fishery Research and Information Centre in Bijapur district and a Canine Research and Information Centre on Mudhol breed of dogs have been started. Efforts are being made for conservation of Deoni breed of cattle. Forty species of ornamental fishes have been identified from the Western Ghats, out of which 16 are ready for commercialization. A Rapidot diagnostic kit has been developed for white spot disease. NBFGR Centre, Kochi informed that they have recorded 347 species of fish in the region, out of which 110 are of ornamental value.

The Chairman expressed concern over the declining trend in agriculture in Kerala State. Dr. Gopalakrishnan, Director of Research, KAU informed that the most serious issue in Kerala is

the acute shortage and high cost of labour. KAU has launched a Food Security Army to develop trained labour force to overcome labour shortage. The Chairman enquired about the land use plan for the State. It was informed that LUP is mainly based on multi-tier cropping system including coconut, pepper, pineapple, tuber crops etc. During the last two years, KAU has developed 14 varieties including seven paddy varieties. The University had been addressing location specific problems in mechanization and has developed a prototype machine for harvesting *pokkali* paddy under submerged condition. The University has standardized an ideal model for precision farming that is being scaled up. KAU has introduced the concept of Agricultural Cadet Corps in the lines of NCC with the objective of building confidence, professional ethics and values in the agricultural sector.

Total animal population is coming down in Kerala. Paucity of fodder and high cost and non-availability of labour are serious concerns affecting the growth of the Animal Husbandry sector. Kerala Veterinary and Animal Science University has identified areas with mineral deficiency and corrective action has been taken. Efforts are being made to conserve endemic breeds like Kasaragod dwarf, Kuttanad buffaloes, Tellicherry chicken etc. It was mentioned that low SNF and infertility are the two major problems. Efforts are being made to develop package of practices to lower blood urea and nitrogen, and to develop nutrient formulations for countering riboflavin deficiency. The University has also evolved an effective waste disposal system through aerobic composting technique.

The Kerala University of Fisheries and Ocean Studies is planning to start five new PG programmes including three in ocean studies. A Seed Bank for ornamental fish and aquaculture of important fishes are being established. The university is focusing on the conservation of fish genetic resources of the Western Ghats, particularly those classified as endangered species. The University is also focusing on aquaculture in relation to *Pokkali* cultivation.

The need for integration of R&D activities and regular interaction of R&D organizations in the States was stressed for the overall development of the state. The Chairman suggested that each ICAR Institute should have two or three flagship programmes in the XII Plan. There should be a coordination mechanism among the SAUs, ICAR Institutes and the line departments to address the specific issues of each state.

The Director of Research, TNAU briefed the forum on the research progress made by the University. The papaya mealy bug which was a serious problem on papaya, cotton, mulberry and cassava had been successfully managed through the deployment of the parasitoid *Acerophagus papayae*. Seed production is a major problem and many recently released varieties could not reach the farmers because of inadequate seed production. The forum felt the need for moderating the breeder seed production.

TNAU has recently introduced new M. Tech. courses in Nanotechnology, Geoinformatics, MBA course in Forestry and M. Sc. in Plant Genetic Resources. The Chairman felt that the SAUs should start diploma courses in skill development, besides exploiting the distance learning and non-formal learning options. It was felt that private agricultural colleges need to be affiliated to the Agricultural Universities to ensure quality education. The Director of Extension Education informed that through KVKs several technologies have been demonstrated and validated. The technologies demonstrated are now being scaled up with the support of various agencies.

Two veterinary colleges have been started by TANUVAS in the previous year and a new undergraduate course on B. Tech. in poultry production has been started. TANUVAS has developed specific mineral mixtures for different parts of the state and the technology has been transferred to Aavin. The University has also made significant contribution in addressing issues like estrus synchronization. The infertility problem in buffalo and the declining population of buffaloes are two major issues in the state. New diseases like the infectious bronchitis in poultry in Namakkal area, infectious laryngo tracheitis and avian influenza are emerging.

There was a suggestion to post an Animal Scientist at KVKs to provide technical support in view of the perceptible growth in animal husbandry sector. TANUVAS recommends antibiotic treatment for mastitis as the causal organism, *Staphylococcus* is very difficult to eradicate. It was informed that FMD is a serious problem in the State and two times vaccination is advocated. A facility for monitoring pesticide and antibody residues in egg has been established. TANUVAS has developed vaccines against major animal diseases and requires a large experimental facility for validating the vaccines.

The Chairman sought the response of the ICAR officials, directors and other functionaries on the issues raised by the state departments and the Universities. Dr. Bansal, Director, NBPGR mentioned that only a few SAUs have complied with the recommendation on accessioning the germplasm with NBPGR. NBPGR is developing an Agro-biodiversity platform networking ICAR Institutes and SAUs for collection, characterization and conservation of agro-biodiversity in the Country. The medium term storage facility available at Thrissur and Hyderabad centres of NBPGR at may be used for storage of germplasm by the SAUs and Institutes. It was suggested that there is a need for obtaining *dicoccum* wheat germplasm from CIMMYT, Mexico for strengthening the *dicoccum* breeding programme, particularly in Karnataka.

Dr. James George, Project Coordinator, Tuber Crops informed that the area under tuber crops is on the decline, but the productivity has increased. The possibility of using sweet potato for dual purpose i.e. for consumption and fodder was discussed. In the region, potato cultivation is largely confined to Nilgiris where 4500 ha are under the crop. Nematode continues to be a major problem in potato in the hills. The new variety Kufri Neelima, resistant to cyst nematode and late blight is ready for distribution. In Kerala, nearly 3000 acres in Idukki district is growing potato. The area is facing severe problem of late blight and technical support is provided by CPRI Regional Station.

Dr. Prabhukumar, Zonal Project Director mentioned that 80 KVKs functioning in the region are validating the package of practices and other technologies. KVKs could also participate in the seed production if the parental lines are provided. The issue of frequent transfer of KVK staff particularly Programme Coordinators was discussed and it was suggested that the transfer of KVK staff should be kept minimum. SAUs and ICAR Institutes should provide the latest technologies to KVKs for assessment, refinement and demonstration. It was emphasized that the income generated from Revolving Fund should be given to KVKs for infrastructure development.

Director, NBAII mentioned about the possible invasion of *Brandispa*, a serious threat to coconut cultivation which may enter our country. He informed that NBAII is ready to cooperate with UPASI in mapping the biodiversity of parasitoids and predators in tea plantations. The Chairman suggested that there is a need for continuous monitoring to locate effective parasitoids

particularly in the context of new pests emerging across crops. He asked the scientists to estimate the savings made through the deployment of parasitoids for the control of papaya mealy bug. There was also a discussion on the registration of bio-pesticides and bio-formulations with the Central Insecticide Board and the forum felt that they need to be registered by the SAUs and the Institutes concerned.

Dr. Faruqui, Director, IGFR gave an overview of fodder research in the region. TNAU has identified TNCN 074 and Mandya centre of UAS has developed 48 MST0814 which have been released for cultivation. IGFR is giving emphasis on dual purpose varieties for fodder and grains and suitable cropping systems of such varieties are being developed. It was mentioned that under dry land farming, the animal component improves the livelihood options of the farming community and there is a need for fodder research under dry land situations.

Dr. Prasad, Director, NIANP stressed the need for creation of quality database on the district wise availability of green fodder. He mentioned that NIANP has developed a technology for making feed blocks from areca sheath which is becoming very popular in Shimoga district and a prototype machine for chopping areca sheath is being developed. The mineral maps of most of the states are currently available based on which feeding of animals has been optimized. Referring to the embryonic mortality in buffalo, it was informed that the oxidatory stress could be reduced by modifying the diet. Azolla cultivation, a supplement to the green fodder, has picked up in Karnataka and Tamil Nadu.

CMFRI has been successful in tracking the movement of yellow fin tuna by satellite. The Institute has also come out with recommendations for optimum fleet sizes for the maritime states. The Institute is actively engaged in biodiversity conservation, coral preservation and mangrove restoration. Two new products for human consumption, viz., green mussel extract and green algae extract are ready for commercialization. The technology for brood stock and seed production in Cobia and Pompano developed by Mandapam centre of CMFRI has been demonstrated in Kerala and Tamil Nadu.

The Fisheries Department of Tamil Nadu informed that the department is installing artificial reefs for stock enhancement in five coastal districts. The Department has also started conversion of mechanized fishing boats to Tuna long liners with a subsidy of Rs. 5 lakhs per boat. It also has a plan to launch mother vessels which could carry 8 - 10 baby vessels to facilitate mid sea fishing and has plans to stock trout in Nilgiris waters.

Dr. Ponnaiah, Director, CIBA discussed the disease problems in brackish water fish culture. A network project is planned on aquatic health which will address all diseases issues. CIBA has perfected the technique for nursery rearing of crabs. Fisheries Colleges had been given the required inputs for monitoring the antibiotic residues present in fish and fish products. The Chairman mentioned that there is lot of scope for fresh water aquaculture in northern Karnataka. The technologies developed by CIBA and its Centres need to be passed on to the Universities and KVKs for adoption. Conservation and management of fish genetic resources of regional importance has to be done on a collaborative mode.

The major technologies such as solar dryer and effluent treatment plants developed by CIFT were elaborated by Dr. Srinivasa Gopal, Director. The post harvest losses are considerable

due to the inadequate support of processing facilities and waste management also is a major issue. There is a need to develop mechanical peelers because of the increasing labour costs. The Chairman suggested that attention should be paid to the fishery sector of Lakshadweep especially marine fisheries management and post-harvest technology. CMFRI and CIFT should focus on improving Tuna export from the islands.

Dr. Rahman, Director, PD ADMAS, requested an AICRP Centre in Tamil Nadu to get information on animal diseases. The Chairman suggested that PDADMAS should advise the State Governments on the likely occurrence of diseases and their management including frequency of vaccination, dosage and monitoring aspects. Dr. Venkataraman, JD, IVRI Regional Centre, Bangalore informed that there is a major control programme in the region for three important diseases like FMD, PPR and Brucellosis. The support and active participation of the development department is absolutely necessary for the success of the programme. He cautioned that the diseases like HPI should be dealt by high security animal disease laboratory only in view of security concerns.

NDRI Regional Centre, Bangalore has developed 23 different dairy products and provides technical support and training in their production. In the dairy sector, acute manpower shortage exists and there is a need for re-organizing the dairy diploma programmes as per the AICTE norms.

Dr. Sidhu, Director, IIHR said that there is increase in the production of fruits and vegetables in the three states. In Tamil Nadu, the productivity of vegetables and fruits is high and drip irrigation could be one factor contributing to high productivity. IIHR has several technologies for horticulture crops that are available for all the SAUs and KVKs.

Tamil Nadu stands first in coconut productivity followed by Kerala and Karnataka. In Tamil Nadu, root wilt disease is spreading in Theni, Tirunelveli (Shengottai) and Kanyakumari districts. It is necessary to slow down the spread of disease by developing a border belt. Areca YLD is a serious problem in Kerala and Karnataka and integrated practices are available to improve productivity of the affected palms. CPCRI has developed virgin coconut oil production technology and it has been passed on to commercial firms.

The CIAE centre at Coimbatore has developed a number of implements and is promoting mechanization in many crops. Paddy transplanter is becoming popular and the centre is conducting training for farmers in raising mat type nurseries. In collaboration with Sugarcane Breeding Institute, the centre has developed bud chipping machines and a transplanter to transplant bud chip seedlings. The Chairman suggested that the Centre needs to be strengthened in terms of manpower and infrastructure.

CSWRI, Mannavanur maintains and distributes rabbit breeds. There are over 500 rabbit farms in Tamil Nadu. The sheep and rabbit wool produced are of export quality and used by the local knitting industry for making quality knitwear.

Dr Jonathan, Director, CPPS, TNAU made a presentation on the control of papaya mealy bug by deploying the parasitoid *Acerorhagus papayae*. In all, 36 research stations, 7 colleges

and 14 KVKs were involved in mass production and distribution of the parasitoids. It was suggested that the economic impact of this technology may be worked out.

Dr Umesh Srivastava mentioned that the tuber crops varieties developed by the CTCRI are high yielding and good in quality. The mosaic resistant cassava variety CMR-1 identified through farmers participatory programme is becoming popular in Tamil Nadu. The overall scenario in horticultural crops is encouraging. Cashew is an important crop in the region occupying nearly 4.0 lakh ha in the three states. DCR, Puthur has developed high yielding varieties and they produce planting material of the new varieties on a large scale.

Dr. Gupta, ADG, Animal Science informed that cattle improvement programme in the region has been taken up under network/AICRP/outreach projects. Efforts are on to conserve and improve the traditional breeds like the Toda buffalo of Nilgiris and the Umbalacherry cattle of Tanjore. There are 1.8 million crossbreds in Tamil Nadu, 0.7 million in Kerala and 0.9 million in Karnataka. The production level in the region is low compared to Punjab and Haryana and there is a need to improve the crossbred population in the region. There is much diversity in sheep in the region as there are 12 breeds, out of which 8 are in Tamil Nadu. There is scope for rabbit farming in the region as demand for rabbit meat is on the increase particularly in Kerala. It was suggested that estrus synchronization protocols developed by TANUVAS and CSWRI should be compared for cost effectiveness and efficiency.

Dr Gopalakrishnan, ADG (CC), ICAR outlined the efforts of the Crop Science Division in strengthening the research activities for improving productivity. DNA fingerprinting data are not forthcoming from the breeders at the time of release of the varieties by the Central Varietal Release Committee. It was suggested that the centrally released varieties should be straightaway approved for cultivation in states as they have already undergone multi-location testing in the states under the AICRP. Transgenic trials are to be conducted only after obtaining NOC from the State Governments after GEAC approval.

Dr Mustafa, Director, NRCB, informed that Tamil Nadu ranks first in banana productivity. NRCB has developed a technology for optimum plant population with fertigation for increasing productivity. The centre has also developed tissue culture techniques to produce 30 - 40 plantlets in 3 - 4 months. The major issues concerning cashew in the region are pests and low productivity. Productivity is the lowest in Kerala due to declining soil health. We do not have dwarf compact types suitable for high density planting. There was substantial damage to cashew plantations in Cuddalore district in Tamil Nadu due to cyclone Thane and production of planting material has been stepped up for replanting the affected plantations.

Non availability of quality planting material is a serious concern in cardamom, pepper and ginger. There is acute shortage of labour for field operations, and mechanization of planting, harvesting and post harvest processing of ginger and turmeric is being taken up by IISR, Calicut. The Chairman suggested that entrepreneur development and custom hiring of processing machines should be explored. The Director, IISR felt the need for importing disease resistant pepper lines and germplasm from Madagascar and Brazil. Thrips is a major problem in cardamom. It was suggested that the centres at Appangala, Sakleshpur and Mayiladumpara should jointly develop packages for cardamom.

Cassava production in the region is increasing despite a decline in area due to improved productivity. Value addition has become essential for sustaining the crop. There is a need to strengthen healthy seed production in cassava. Sugarcane is an important crop in the region. The high cost of cultivation due to escalating cost of inputs and labour is a serious concern. There is an urgent need to develop smaller harvesting machines suitable for small holdings. Sugarcane productivity in the region has remained static for the past two decades. A single variety Co 86032 is dominating the varietal scene occupying over 90% area in Tamil Nadu and over 50% area in Karnataka. Yellow Leaf Disease is affecting the yield in the region. Since the existing varieties are susceptible to YLD, only healthy seed programme based on tissue culture nurseries can sustain the productivity. Drip irrigation and residue recycling are being promoted to conserve natural resources and to improve soil health. SBI has developed technologies for sugarcane juice preservation and the process of spray drying sugarcane juice has been commercialized.

Area and production of cotton has increased in Tamil Nadu and Karnataka, but there is no significant increase in productivity after the introduction of Bt cotton in 2005. Of late, there had been an increase in the pest load, particularly sucking pests, which could be controlled by seed treatment with Imidacloprid. It was also informed that efforts are on to develop interspecific hybrids of cotton at CICR Regional Station, Coimbatore. The IARI Regional Station, Wellington has developed wheat varieties suited for the plains of Tamil Nadu. The Regional Centre of the Central Soil and Water Conservation Research and Training Institute, Ooty is implementing an integrated farming system for small and marginal farmers. The Bangalore centre of NBSSLUP is addressing the issues of Increasing wastelands, nutrient deficiency, salinity, sodicity, over exploitation of ground water etc. that are affecting the region.

Dr M.M. Pandey, DDG, Engineering, informed that farm labour is a serious constraint in the region. Efforts are on to develop and validate machineries and implements suited for various farm operations through the 11 AICRP centres in the region. There is an emergent need for development of renewable energy based technologies particularly Solar Photovoltaic system for meeting the energy needs including lighting and drying of agri-horti produces. The progress made by the Kerala state in mechanization of paddy cultivation including field preparation, transplanting and harvesting through entrepreneurship models is commendable. Tamil Nadu has a very good manufacturing network with which TNAU and CIAE centres are collaborating.

Dr. Meenakumari, DDG, Fisheries, discussed about waste management, use of non-conventional energy sources and mechanization in the fishery sector. She highlighted the technologies developed by CIFT for effluent treatment, conversion of squid waste to fish / poultry feed, use of silage from Tuna heads as feed for cage reared fish and power block to reduce the labour in small scale sea fishing. Major issues in fisheries are quality feed, seed and interventions in disease. Quick fishing and Tuna long lining has been introduced in Lakshadweep as part of Island development. Seven boats under NAIP and nearly 100 boats under the MPEDA scheme have been converted in to Tuna long liners. The optimum fleet size for the region has been worked out. There had been a visible shift in the labour profile in the fishery sector in the region and labourers from Bihar or Bengal are currently engaged in the industry.

Dr. Bangali Baboo, ND, NAIP said that there are 37 lead projects and 128 associate projects being operated in the region under NAIP. There are several success stories from the

region including the flower export technology, red gram transplanting technology, rice-fish-poultry and the pioneering work in agro forestry and millets. He added that both researchable and developmental issues should be addressed to bring a visible change in the agrarian sector.

Dr. K.D. Kokate, DDG, Extension highlighted the importance of the KVKs in technology dissemination and requested the Vice Chancellors to fill up the vacancies of the SMSs on a priority basis and to hold the Scientific Advisory Committee meetings regularly. He particularly commended the performance of the Kannur KVK in Kerala for its good performance. For effective functioning of KVKs district level technology interventions are required for which the necessary inputs have to come from the SAUs and the ICAR Institutes.

Based on the two day deliberations, fourteen recommendations have been made for strengthening and coordinating R & D activities in the Region.

The Chairman in his Concluding Remarks exhorted the research and development departments to make concerted efforts to address the regional issues on a specific time frame. He suggested that state level meetings have to be organized to discuss the problems and issues in the state. He also stressed the need for interdepartmental linkages among the development departments, SAUs and ICAR Institutes for the overall growth and integrated development of the region. It was also suggested that the Universities and Institutes should have a few flagship projects to address the key issues and not diffuse their resources and efforts on too many programmes. Focus should be more on research, which is the core assignment of the NARS. The Chairman thanked all the participants for their effective participation in the deliberations.

BACKGROUND NOTE ON THE ICAR REGIONAL COMMITTEE No.VIII

The Indian Council of Agricultural Research set up eight Regional Committees during 1975 for each of the eight agro-climatic regions of India. These Committees were reconstituted during 1982 for a further period of three years. Thereafter the Regional Committee Meetings became a regular feature and they meet in alternate years, in the different states of the region in rotation. Committees are serviced by the Member-Secretary, who is normally one of the Directors of the Institutes of Indian Council of Agricultural Research, located in the region.

The Regional Committees meet biennially to discuss and review the current status of agricultural research, education and extension to critically examine various problems faced by the Region either in the execution of the approved programmes or in tackling the emergent problems and identify gaps for research by Agricultural Universities and ICAR Institutes or in transfer of known technologies by extension agencies. The functions of the Regional Committees are:

- To review the status of agricultural research and education in the region.
- To analyze, discuss in depth and make recommendations on the location specific problems of agriculture, animal husbandry, fisheries and forestry peculiar to the region.

The Regional Committees provide a unique forum for a meaningful dialogue amongst research and development agencies in the fields of agriculture, horticulture, animal husbandry, fisheries, rural development and agro-forestry. They help in forging an effective liaison and coordination amongst ICAR Institutes, State Agricultural Universities and Departments of Agriculture, Horticulture, Animal Husbandry and Fisheries of the respective State Governments. Hon'ble Ministers of Agriculture, Horticulture, Animal Husbandry and Fisheries of State Governments and Vice Chancellors and scientists of Agricultural Universities, Directors of ICAR Institutes, and Heads of ICAR Research Stations located in the Region, Directors of Agriculture, Animal Husbandry and Fisheries of the State Governments, Members of the ICAR Society and few progressive farmers are invited to participate in these meetings. The meetings help in discussing various constraints in the implementation of various programmes related to research, education and development of agriculture in the region and in finding practicable solutions in overcoming the constraints through joint efforts. Important recommendations arising out of the deliberations at the meeting are communicated for necessary action to the concerned State / Central Agricultural University / Line Department / Agency.

The Region No. VIII consists of the states of Karnataka, Kerala and Tamil Nadu, and Union Territories of Puducherry and Lakshadweep islands.

REGION No. VIII (NOT TO SCALE)



3. Karnataka plateau hot arid eco sub region (ESR)
6. Deccan plateau - hot semi-arid eco-region
- 6.1. North Karnataka Plateau, hot dry semi-arid ESR
- 6.4. Moderately to gently sloping North Sahyadris and Western Karnataka Plateau, hot dry sub humid ESR
8. Eastern ghats and Tamil Nadu uplands and Deccan (Karnataka) plateau, hot, semi-arid eco region
- 8.1. Tamil Nadu Uplands and Leeward flanks of South Sahyadris, hot dry semi-arid ecosubregion
- 8.2 Central Karnataka Plateau, hot moist semi-arid ESR
- 8.3. Tamil Nadu Uplands and Plains, hot moist semi-arid ESR
18. Eastern coastal plain, hot sub humid to semi-arid eco-region
- 18.1. South Tamil Nadu Plains (Coastal), hot dry semi-arid ESR
- 18.2. North Tamil Nadu Plains (Coastal), hot moist semi-arid ESR
19. Western ghats and coastal plain, hot humid-per humid eco-region.
- 19.2. Central and South Sahyadris, hot moist sub humid to humid transitional ESR
- 19.3. Konkan, Karnataka and Kerala Coastal Plain, hot humid to per humid transitional ESR
20. Islands of Lakshadweep, hot humid to per humid island eco-region.

PROGRAMME

XXIII MEETING OF ICAR REGIONAL COMMITTEE No. VIII

June 15, 2012 (Friday)

INAUGURAL SESSION

<p>Venue</p> <p>Anna Auditorium Tamil Nadu Agricultural University Coimbatore 641003</p>	
Welcome Address	<p>Dr. P. Subbian Registrar & Acting Vice Chancellor TNAU, Coimbatore</p>
Introductory Remarks	<p>Dr. K. D. Kokate Deputy Director General (Extn.) ICAR, New Delhi</p>
Release of publications/products	
Presidential Address	<p>Dr. S. Ayyappan Secretary (DARE) & Director General, ICAR</p>
Inagural Address	<p>Shri. S. Damodaran Hon'ble Minister for Agriculture Government of Tamil Nadu</p>
Vote of Thanks	<p>Dr. N. Vijayan Nair Member Secretary, ICAR Regional Committee No. VIII & Director, Sugarcane Breeding Institute</p>

June 15 & 16 2012 (Friday & Saturday)
TECHNICAL SESSION

Venue
Seminar Hall
RI Building, TNAU Coimbatore

Opening Remarks	Dr. S. Ayyappan Secretary (DARE) & Director General, ICAR
Presentation of the Action Taken Report on the XXII Meeting of ICAR Regional Committee No. VIII held at Bengaluru on 13 – 15 May 2010	Dr. N. Vijayan Nair Member Secretary

Fresh Agenda Items
State-wise Problems and Research Needs / Development issues

A-1	Statement on Development Issues / Research Needs of Tamil Nadu	Officials of the Line Departments (Agri. / Horti. / Animal Husbandry / Fisheries), Govt. of Tamil Nadu
A-1	Response to the above	VCs / Deans / DRs / DEEs of TNAU, Coimbatore / TANUVAS, Chennai
B-1	Statement on Development Issues / Research Needs of Kerala	Officials of Line Departments (Agri. / Horti. / Animal Husbandry / Fisheries), Govt. of Kerala
B-2	Response to the above	VCs / Deans / DRs / DEEs of KAU, Thrissur / KVASU, Thiruvananthapuram / KUFOS, Kochi
C-1	Statement on Development Issues / Research Needs of Karnataka	Officials of Line Departments (Agri. / Horti. / Animal Husbandry / Fisheries), Govt. of Karnataka
C-2	Response to the above	VCs / Deans / DRs / DEEs of UAS, Bangalore / UAS, Dharwad / UAS, Raichur / UHS, Bagalkot / KVAFSU, Bidar
D-1	Statement on Development Issues / Research Needs of Puducherry	Officials of Line Departments (Agri. / Horti. / Animal Husbandry / Fisheries), Govt. of Puducherry

Responses of Directors of ICAR Institutes

Responses of Project Co-coordinators / Heads of Regional / Research centres of ICAR Institutes

Response

1. Crop Sciences	DDG (CS)
2. Horticulture	DDG (H)
3. Natural Resource Management	DDG (NRM)
4. Agricultural Engineering	DDG (Engg)
5. Animal Breeding, Health & Nutrition	DG (AS)
6. Fisheries	DDG (Fisheries)
7. Agricultural Education	DDG (Edn.)
8. Agricultural Extension	DDG (Extn.)
9. NAIP Implementation	ND (NAIP)

Remarks by representatives, Govt. of India

Remarks by ICAR GB / Society Members:

Shri Sudhir K Bhargava

Concluding Remarks and Action Points

Secretary, DARE &
Director General, ICAR

Vote of Thanks

Member Secretary



**Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu
lighting the lamp during the Inaugural Session**



**Dignitaries on the dais during the Inaugural Session
(From left to right: Dr. Ravindra Kumar, Dr. P. Subbian, Thiru S. Damodaran,
Dr. S. Ayyappan, Dr. K.D. Kokate and Dr. N. Vijayan Nair)**



Dr. S. Ayyappan, Secretary (DARE) and Director General (ICAR)
delivering the Presidential Address



Dr. K.D. Kokate, Deputy Director General (Agricultural Extension), ICAR
giving the Introductory Remarks



Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu releasing 'Mineral Mixture' formulated by NIANP, Bengaluru



Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu releasing a publication



**Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu
releasing the CD on 'e-course for B.V.Sc. and A.H. degree programme**



**Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu
in conversation with Dr. S. Ayyappan, Director General (ICAR)**



Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu
honouring the 'Best Banana Farmer'



Shri S. Damodaran, Minister for Agriculture, Government of Tamil Nadu
delivering the Inaugural Address



Dr. S. Ayyappan, Secretary (DARE) and Director General (ICAR) addressing the participants during the Technical Session



A view of the participants in the Technical Session



Deputy Directors General of ICAR in the Technical Session



Vice Chancellors of SAUs in the Technical Session

CHAPTER I

INAGURAL ADDRESS DELIVERED BY SHRI S. DAMODARAN, HON'BLE MINISTER FOR AGRICULTURE, GOVT. OF TAMIL NADU

At the outset, I extend a very warm welcome to the Director General and Deputy Directors General of ICAR, Vice Chancellors of Agricultural Universities and other Officers.

India accounts for 18% of the World's population. As stated by Mahatma Gandhi, Father of our nation long ago villages are the mainstay of the Indian economy and 70% of the rural population is dependent on agriculture and allied fields. Agriculture contributes 13.9% to the GDP of the nation.

India with 2 % of the world's total land area and 1.5 % of the world's forests has 15 % of the animal population. The average size of farm holdings in the country, which was 0.48 ha in 1951 has decreased to 0.16 ha and 96% of the Indian farmers are small and marginal farmers. Farmers are struggling throughout the year due to factors like climate change, water and air pollution and globalization policies. This clearly brings out the need for greater attention to agriculture.

Agriculture today is in a crisis. Farm lands are being sold. Farmers are struggling because of climate change, soil water and air pollution and changing globalization policies. The XXIII meeting of the ICAR Regional Committee No. VIII is being organized at Coimbatore under this situation.

Our ancestors have classified the land into different categories and farmed accordingly. Today, we have fine-tuned the technologies practiced by our ancestors and adopting them. There are adages in ancient Tamil scripts which describe beautifully the spacings required for different crops.

Today similar to the system adopted by our ancestors, the country has been divided into eight regions based on the agro-climatic conditions. The agro-climatic and soil conditions vary from region to region. For selecting suitable crops and cropping patterns based on the climatic conditions, meetings like these are highly useful to the scientists, agricultural students, farmers and even all living organisms.

The population of the country which was 33 crores at the time of independence has crossed 120 crores. Achieving self-sufficiency to meet in the basic needs like food, clothing and shelter is in the hands of the researchers. Globalization places a high premium on educations and skills. Therefore research organizations and financial institutions like World Bank are searching answers for these. There is a shortage of professionalism and managerial capacity. ICAR and educational institutions should follow new approaches to find suitable answers for the above programmes.

ILO, Geneva has stated "To adapt education, training systems which will improve the competence and employability of the present youth so as to bridge the gaps between knowledge acquired in formal education and that learnt in work are essential". We have realized that good

education with appropriate training and job oriented courses should aim at bridging the gap between formal education and practical knowledge. In Agriculture, conventional or formal agricultural education alone cannot ensure success. Today the focus on agricultural education is returns on investment, market led extension and entrepreneurship development.

Only by following the above, we can increase the contribution of agriculture to the economic development of our nation. If we are to achieve 8.9% economic growth, agricultural production has to be increased by 4%. The researchers will play a key role in achieving this 4% growth during the XII Five Year Plan.

Today the farmers are forced to sell the produce at the price dictated by the merchants. This may be due to factors like economic conditions, need to repay the loans and lack of storage facilities for the produce. Therefore, we should strive hard to convert fruits, vegetables and flowers into value added products. Agricultural research stations should guide the farmers to focus on commercial agriculture and train them in marketing techniques and strategies.

India stands second in the world in the production of wheat, rice, cotton, ground nut and sugarcane. India accounts for 10% of the world's fruit production and stands first in the production of banana, mango and sapota. However, in our country, during harvest season, there is a glut in food grains, fruits and vegetables and there is 60% market surplus. Six percent of the food grains valued at Rs. 21,500 crores are lost. Therefore, farmers should decide their cropping pattern based on the market situation, available stock, requirements and support price. Research institutions and Universities should help in this regard. Establishments like DEMIC (Domestic and Expert Market Intelligence Cell) of TNAU should advice and help farmers in this connection. Besides, 88% of the fruits and vegetables come to the market during the harvest season. 25 to 35% of these produces, valued at Rs. 45000 crores are wasted. To avoid these, the research on food processing and value addition should be intensified.

In recent years, there is acute shortage of labour which affects the farming activities. This is mainly due to the Mahatma Gandhi Rural Employment Guarantee Scheme for which 33000 crores of rupees has been allotted during the current year. Though this has ensured regular income to the rural people, it resulted in acute labour shortage which is destroying agriculture. Mechanization and development of suitable farm machinery to overcome the labour shortage is a big challenge to the researchers. Modern techniques like System of Rice Intensification, System of Sugarcane Intensification and System of Cotton Intensification have increased the use of machineries. The researchers should develop and make available farm machinery like cono weeders, markers, sugarcane harvesters, sugarcane planters, rice planters and rice harvesters to suit the different regions and situations. This requires the special attention of the scientists. The Government of Tamil Nadu has announced many schemes to mechanize agriculture.

Water sharing has become an unavoidable problem among the states. It has been estimated that the available water in Tamil Nadu by the year 2025 will be only 4.74 million hectare metres against the requirement of 6.20 million hectare metres, resulting in 31% of water deficit. We should take advance planning and action to face this future shortage. Considering

this, Government of Tamil Nadu has given 100% subsidy to small and marginal farmers and 75% subsidy to others for installing micro irrigation systems.

As agriculture is facing several challenges, the people are migrating to the cities and towns in increasing numbers. According to the 2011 census, the rural population has come down by 10%. People are migrating to towns because they are not able live on agriculture. ICAR Institutes should develop plans to make agriculture an industry at the village level. In addition, the education should encourage the students to start their own industries. In this context, we should follow the example of the well-known biotechnologist, Kiran Majumdar who used her education to become an industrialist in Biotechnology. Universities and Research Institutions should not stop with technical education, but give education that will help to start industries. “Do not work for certificates; do your duty; automatically appreciation, rewards and great people will come to you” as told by Shri Pawan Agarwal, President of the Mumbai Dubbawala’s Association who had been felicitated by Prince Charles and Oxford / Cambridge Universities. The educational institutes should teach that team work, commitment, discipline, honesty and time management will alone ensure success.

On this occasion, I request ICAR to intensify research on climate resilient agriculture, soil based cropping programme, locality based mechanization, higher returns for every rupee invested, market led extension, new innovations to update the capacity of the youth through research on technologies like GPS, GIS and remote sensing, food processing and value education, improving ethanol production from molasses, inter linking agriculture and animal husbandry, nanotechnology and effect of El-Nino.

TNAU is one of the topmost Universities in India that has developed several new technologies. Transfer of these technologies to the farm helped Tamil Nadu to achieve record food grain production of 105 tonnes. On this occasion, I request ICAR to give more financial support to this prestigious University.

I THANK ONE AND ALL.

CHAPTER II

ACTION TAKEN REPORT ON THE RECOMMENDATIONS OF THE XXII MEETING OF ICAR REGIONAL COMMITTEE NO. VIII HELD AT BANGALORE DURING MAY 13 – 15, 2010

No.	Action Point	Action Taken
1	There should be an integrated approach to extension activities. At present Universities, Departments, ICAR Institutes and NGOs carry out extension activities independently. These activities should be integrated to avoid duplication, contradiction and to ensure effective transfer of technologies (SAUs, Institutes, ZPD, Departments).	All the KVKs have representatives of ICAR institutes, NGOs & Development Departments in their SACs. Action Plans are finalized taking inputs from all these representatives. Moreover, ATMA functioning in each district also provides a platform in formulating programmes integrating these agencies. In future also programmes will be chalked out integrating various agencies. DEE, KAU
		At present the University is conducting bi-monthly technical workshops involving scientists from UAS Bangalore and Officials from Line Departments. University will also involve scientists from ICAR Institutes located in the region in future. Scientists of the University and SMSs of KVKs are participating in several extension activities of the line departments and effective transfer of technologies is being ensured. DEE, UAS-Bangalore
		The Action Plan for training at each KVK of UAS, Dharwad is being finalized in consultation with Dept., ICAR institutions and NGO partners based on location specific problems and to address the necessities of the farmers. Further the Annual Action Plan of KVKs would be finalized by ZPD at zonal level. DEE, UAS-Dharwad
		For some of the new technologies like red gram transplanting, paddy transplanting, combined harvesters, machine operated sprayers etc. both the universities and departments are jointly organizing field days, farmers tour etc. in an integrated manner. DEE, UAS-Raichur
		The Extension activities of UHS, Bagalkot are organized in collaboration with the State Departments besides involving ICAR institutes (IIHR, Bangalore, NRC cashew Puttur) and wherever relevant NGOs (IAT, All India Grape Growers Association, Bijapur, All India Pomegranate Growers Association, Bagalkot etc.). DEE, UHS-Bagalkot
		Karnataka Veterinary Animal & Fisheries Sciences University (KVAFSU) is carrying out extension activities in an integrated mode. A grand "Januvaru Matsya. Krishi & Totagarika Mela-2011" was organized during 28 - 30 December, 2011 at Bidar in collaboration with UAS Raichur and UHS Bagalkot. The University is also working with UAS Bangalore, UAS Raichur

No.	Action Point	Action Taken
		<p>and UHS Bagalkot and NGOs for a consortium project on "Livelihood security through resources and entrepreneurship management in Bidar district" and "Integrated farming systems approach in Chitradurga district. The University is also working with UAS Raichur on "Redesigning the farmer extension - Agricultural research / education continuum in India with ICT mediated knowledge management". .</p> <p>KVAFSU, Bidar is carrying out extension activities through integrated approach involving Department of AH/VS, Department of Fisheries, KMF, ATMA and SAUs through its Extension Education Units attached to every constituent college, Livestock / Fisheries Research and Information Centres etc. This has minimized the duplication of activities, enabling the effective transfer of technologies among livestock and fisheries farmers of the state.</p> <p style="text-align: right;">DEE, KVAFSU Bidar</p> <ul style="list-style-type: none"> • All the capacity building programmes are being organized at Training Division and State Agricultural Management and Extension Training Institute. In-service training programme for the concerned district officials are now being organized only at the respective KVK of the district. • All the KVKs are organizing Master level, Hi-tech and Specialized training for the farming community. General training programmes regarding crop cultivation are now being organized at Farmers training centre / NGO of the respective district. The inbuilt training in the schemes implemented in Tamil Nadu is organized by the State Agriculture Department and KVK scientists are participating as resource person only. Need based vocational training are being organized only at KVK level. • KVKs are advised to prepare the Annual Action Plan in consultation with Agriculture department, Animal Husbandry department and other line departments so that duplication of works may be avoided. <p style="text-align: right;">DEE, TNAU Coimbatore</p> <p>At TANUVAS, Extension activities are being carried out in collaboration with ICAR and Line Departments viz. State Animal Husbandry Department, Aavin, ATMA and other rural development organizations / banks like NABARD, SBI etc. The University has organized 16 training programmes benefitting 1211 persons during 2010 - 11.</p> <p style="text-align: right;">DEE, TANUVAS Chennai</p> <p>The outreach activities of the institute at the village level include conducting field level demonstrations on recent cane technologies, awareness campaigns, field days etc. All the extension activities are being carried out in close coordination with the sugar factories concerned / KVKs in the region.</p> <p style="text-align: right;">SBI, Coimbatore</p>

No.	Action Point	Action Taken
		<p>Efforts have been taken to integrate the extension activities of the Institute with the extension activities of SAUs, Departments and NGOs. Front Line Demonstrations have been conducted in an integrated manner involving the SAUs and CICR in the cotton growing states of India.</p> <p>CICR RS, Coimbatore</p>
		<p>Research findings of the Bureau as well as AICRP on Biological Control of Crop Pests and Weeds are passed on to the Plant Protection / Entomology Departments of SAUs so that a harmonized activity is facilitated through the linkages of the university with the line departments of Agriculture / Horticulture.</p> <p>NBAII, Bengaluru</p>
		<p>IIHR is carrying out extension activities like trainings, demonstrations, exhibitions etc. in collaboration with Departments, SAUs, NGOs, Zonal Project Directorate and Financial Institutions. The main aim of our activities is to converge the programmes of various organizations.</p> <p>IIHR, Bengaluru</p>
		<p>Recommendations on technologies are communicated to Development Departments through publications, training programme, Annual Cashew Day etc.</p> <p>DCR, Puttur</p>
		<p>Noted for guidance</p> <p>IISR, Calicut</p>
		<p>The front line extension activities of the Institute are conducted with the active collaboration of State Agri. / Hort. Departments and NGOs. Participation of extension personnel representing State Govt. Departments and NGOs are ensured in the technology transfer activities of the Institute.</p> <p>CPCRI, Kasaragod</p>
		<p>Integrated approach to extension activities already in vogue to ensure effective transfer of technologies.</p> <p>CTCRI, Trivandrum</p>
		<p>The technologies developed by NRCB are communicated to the SAUs for integrating into their activities and have been disseminated to the KVKs for implementation. NRCB is participating in the Scientific Workers Conference of SAUs and Scientific Advisory Committee Meetings of KVKs to avoid duplication and contradiction relating to technologies on banana. The Centre is participating in Kissan Melas, Agrcultural Exhibitions, Farmers' Meet and other extension activities to disseminate technologies on banana developed at NRC Banana.</p> <p>NRC Banana, Trichy</p>

No.	Action Point	Action Taken
		<p>AICSMIP is actively collaborating with NGOs like DHAN foundation and Ramakrishna Mission for extension of technologies in remote and tribal areas in the states of Jharkhand, Odisha and Andhra Pradesh</p> <p style="text-align: right;">AICSMIP, Bengaluru</p>
		<p>An integrated approach is being followed by involving the KVKs, Universities, State Departments and NGOs while organizing the training programmes and exhibitions.</p> <p style="text-align: right;">CIFT, Kochi</p>
		<p>CIBA works in close collaboration with TANUVAS, Navsari Agricultural University, State Fisheries Departments, NGOs like MSSRF, Aquaculture Foundation and SHGs and other Fisheries Research Institutes of ICAR and DRWA, Bhubaneswar for transfer of technologies as well as collaborative research.</p> <p style="text-align: right;">CIBA, Chennai</p>
		<p>The institute carries out its extension activities in an integrated approach along with a.) KVK, Hadonahalli, UAS, Bangalore, b.) KVK, Babbur Farm, c.) Karnataka Milk Federation, d.) MYRADA, e.) NISRGA and f.) AWAKE.</p> <p style="text-align: right;">NIANP Bengaluru</p>
		<p>The PD ADMAS carries out epidemiological investigations at national level. For this, it has 15 centers spread across the country. The field activity of the Institute is through these units, majority of them being state Animal husbandry departments and a few being the veterinary colleges. There is a good rapport with these units and there is neither duplication nor contradiction. The technologies developed are transferred to the field with the help of these units.</p> <p style="text-align: right;">PD ADMAS, Bengaluru</p>
		<p>Their main objective of KVKs is to evolve location specific technologies through Technology Assessment and Refinement and dissemination of the same through Frontline Demonstrations and other extension programmes. The action point is well taken care by the KVKs during their Scientific Advisory Committee meetings, action plan and annual review meetings.</p> <p>The Interface meetings between KVKs and all the stakeholders was completed for Kamataka, Kerala, Goa and Lakshadweep. The same will be conducted for Tamil Nadu and Puducherry during November 2011 and based on the recommendations of these Interface meetings, more emphasis will be focused on integrated approach to extension activities.</p> <p style="text-align: right;">ZPD, Bengaluru</p>

No.	Action Point	Action Taken
		<p>The Bureau is providing necessary soil / land resource information to all the, SAUs / ICAR Institutes / KVKs and line departments of Agriculture / Horticulture / Forestry and NGO's whenever they take up Transfer of Technology activities. Bureau is not involved in Agro Technology Transfer.</p> <p style="text-align: right;">NBSSLUP, Bangalore</p>
		<ul style="list-style-type: none"> • The research centre is participating in the Monthly Zonal Workshops, farmers' day programmes and training programmes under National Horticulture Mission organized by Dept. of Horticulture, the Nilgiris. • Resource persons from the Dept. of Horticulture and TNAU are invited for the training programmes organized by the Centre on watershed management. The Centre as a member of Scientific Advisory Committee of UPASI KVK and takes their help in on farm testing and transfer of the technologies. • The technologies developed by TNAU and TANUVAS are being transferred directly to farmers' fields in our watershed programmes at Salaiyur (Coimbatore district), Ayalur (Erode district) and Iduhatti (The Nilgiris district). This Centre participates in the Scientific Workers Conference at TNAU, Coimbatore and makes presentation on the technologies developed for incorporating the package of practices. <p style="text-align: right;">CSWCRI, Ooty</p>
		<p>We are having collaboration with ARS Hagari and KVK Bellary, for supply of seed material. We also work with UAS Dharwad for supply of seed material of groundnut, bengal gram etc. But these are very short lived collaborations and usually end with the termination of the Watershed project. <i>The State Agricultural Department and the Watershed Development Agency rarely show any interest in working in collaboration with central agencies.</i></p> <p style="text-align: right;">CSWCRI, Bellary</p>
		<p>The extension activities of our Centre are always conducted in collaboration with the State Fisheries Departments, Universities (UAS, Bangalore and KVAFSU) and other organizations. Other organizations are also intimating about their extension activities (related to our programmes) and we are also pro-actively participating in such events</p> <p style="text-align: right;">CIFRI, Bangalore</p>
		<p>The Department of Agriculture in co-ordination with Department of Sugar has initiated steps to conduct Crop Cutting Experiments to make correct projection of sugarcane yield. Integrated approach with TNAU and Sugarcane</p>

No.	Action Point	Action Taken
		<p>Breeding Institute will be initiated shortly to avoid duplication and to ensure effective transfer of technologies.</p> <p style="text-align: right;">DoA, Tamil Nadu</p> <hr/> <p>Department of Agriculture has started an integrated approach in extension activities by integrating the activities of University, Department, ICAR institutes and NGOs for the effective transfer of technologies to the farmers. This programme named as LEADS has been started in Kollam and Palakkad districts. This will be extended to other districts also.</p> <p style="text-align: right;">DoA, Kerala</p> <hr/> <p>The SAUs are implementing integrated farming system projects in an area of 25000 ha in each Agricultural University, with effective participation of line departments namely, Agriculture, Horticulture, Animal Husbandry, Sericulture, Fisheries and Forest Departments.</p> <p>Karnataka Krishi Mission has been established with an objective to induct new ideas, sensitize and develop new plans, projects & programmes for agriculture and SAUs and line departments. Effective transfer of technologies to the farmers, through integrated approach in extension activities is also envisaged. Streamlining and coordinating the functions of line departments and SAUs in the State to provide services from a single window is being contemplated</p> <p style="text-align: right;">DoA, Karnataka</p>
2	Technologies developed by NARS in the region should be listed. ICAR technologies and SAU technologies should be integrated to avoid duplication. Technological inventions brought out by the ICAR/SAUs may be compiled and made available (Institutes, SAUs, ZPD)	<p>Package of Practices (POP) (Crops) is an authentic record that compiles the technologies of SAUs and ICAR institutes in the state and is updated periodically through a workshop arranged for the purpose. The latest edition of POP is under preparation and will be released soon which serves the purpose. In 2008-09, 'Inventory of Recent Agricultural Technologies for Kerala' has been published by Directorate of Extension, KAU and distributed to all KVKs of Kerala.</p> <p style="text-align: right;">DEE, KAU, Thrissur</p> <hr/> <p>The Package of Practices is prepared in consultation with all SAUs, ICAR Institutions in the region and Developmental Departments.</p> <p style="text-align: right;">DEE, UAS Bengaluru</p> <hr/> <p>The crop improvement, production and protection technologies developed and released by NARS and SAUs have been compiled in the form of package of practices in Kannada and being updated annually. These PoP books are printed and distributed to farmers at affordable prices for their benefit. Further these technologies may be integrated at state level and may be published in Kannada.</p> <p style="text-align: right;">DEE, UAS-Dharwad</p>

No.	Action Point	Action Taken
		<p>The listing of technologies developed by NARS is being initiated. The technologies developed by SAUs are location specific and hence they are being implemented and adopted by the farming community. However, the technologies developed by ICAR found suitable in the region are being taken to the field. The compilation of technological inventions brought out by the ICAR/SAUs is yet to be initiated.</p> <p style="text-align: right;">DEE, UAS Raichur</p>
		<p>The technologies developed by the UHS, Bagalkot are sent to ZPD by the Directorate of Research. Scientists from IIHR, Bangalore and other institutes attend the Zonal Horticultural "Research & Extension Council meetings of UHSB and present the ICAR technologies to be released.</p> <p style="text-align: right;">DEE, UHS Bagalkot</p>
		<p>The technologies developed by the University are periodically published as package of practices and copies of the same are made available to the ICAR Institutes of the State. Recently KVAFSU has brought out a documentation on 'Inventory of recent animal and fisheries technologies for Karnataka'</p> <p style="text-align: right;">DEE, KVAFSU, Bidar</p>
		<ol style="list-style-type: none"> 1. All the technologies developed by NARS were documented and listed in our Agritech Portal www.agritech.tnau.ac.in 2. TNAU will develop new technologies or management practices only if there is no solution available either from any SAUs or ICAR system for solving farm related problems. However TNAU will test the location specific suitability of the technology through OFT programmes and handover for adoption. 3. TNAU has published District Specific Agricultural Technologies for Tamil Nadu and Puducherry by incorporating all SAU and ICAR technologies for the district and distributed to all KVKs and Block level agricultural officials for further necessary action. Second version is also updated. 4. Tamil Nadu has developed District Action Plan for next five years; accordingly all the agricultural research and extension activities are being planned and implemented. <p style="text-align: right;">DEE, TNAU Coimbatore</p>
		<p>The University has developed 43 technologies and the same has been released in the form of CD-ROM as well as booklet during 2008. Further 18 technologies have been developed and the same will be published in due course.</p> <p style="text-align: right;">DEE, TANUVAS Chennai</p>

No.	Action Point	Action Taken
		<p>The technologies recommended by the institute have been compiled and uploaded in the website in English, Hindi and Tamil.</p> <p style="text-align: right;">SBI, Coimbatore</p>
		<p>The list of recent technologies developed by CICR, Coimbatore has been prepared. Efforts have been taken to integrate these technologies with SAUs through the annual Scientific Workers Conferences conducted by the SAUs.</p> <p>Under Technology Mission on Cotton (TMC), Director, CICR had taken initiative to conduct multi location trials of the evolved technologies involving the SAUs and Departments to bring out the location specific technologies.</p> <p style="text-align: right;">CICR RS Coimbatore</p>
		<p>Technologies developed by the Bureau have already been listed and communicated to the stakeholders. Technologies developed in AICRPs are discussed by the SAUs in their plant protection conference and harmonized recommendations are made to avoid duplication and contradictions.</p> <p style="text-align: right;">NBAII Bengaluru</p>
		<p>Technologies developed by this Institute have been compiled and a publication has been brought out. The information has been displayed in the Institute Website also. Another publication has also been brought out on the technologies which have been commercialized.</p> <p style="text-align: right;">IIHR Bengaluru</p>
		<p>Technologies have been made available to SAUs to bring about common recommendations to avoid duplication.</p> <p style="text-align: right;">DCR, Puttur</p>
		<p>The list of technologies developed by IISR are given below:</p> <ul style="list-style-type: none"> • Four varieties of black pepper, three varieties each of cardamom, ginger & turmeric and one nutmeg variety • Integrated management of <i>Phytophthora</i> foot rot, slow wilt, spike shedding, pollu beetle, mussel scale and root mealy bugs of black pepper. • Diagnostics / integrated management of viral diseases, rhizome rot, nematodes, shoot borer, thrips and root grubs of cardamom. • Integrated management of rhizome rot disease, shoot borer <i>and</i> rhizome scale of ginger and turmeric and bacterial wilt disease of ginger. • Technologies for mass production of biocontrol agents • Integrated crop management and PHT <p style="text-align: right;">IISR, Calicut</p>

No.	Action Point	Action Taken
		<p>Production technologies developed by the institute for Kerala are included in the Package of Practices published by KAU. Information on processing technologies developed by the institute was sent to ZPD for integrating into KVK activities.</p> <p style="text-align: right;">CPCRI, Kasaragod</p>
		<p>Technological inventions brought out by the Institute are listed and put in the website. Periodical publications on them are also brought out.</p> <p style="text-align: right;">CTCRI, Trivandrum</p>
		<p>Technologies developed by the NRCB have been brought out as Technical and Extension Bulletins depending on the contents and utility. These technologies are discussed in different forums of SAUs so as to avoid duplication</p> <p style="text-align: right;">NRC Banana, Trichy</p>
		<p>The technologies / innovations / breakthrough made by the Institute are being loaded in the website of the Institute and published in the CMFRI Newsletter. This is uploaded in the CMFRI's Open Access Catalogue (Eprints@CMFRI) which is accessible to all.</p> <p style="text-align: right;">CMFRI, Kochi</p>
		<p>The technologies developed by the Institute are compiled by the Institute Technology Management Unit (ITMU), since ITMU is acting as the single window in the Institute for commercialization of technologies.</p> <p style="text-align: right;">CIFT</p>
		<p>Technologies developed by CIBA are brought out as Bulletins, Technology Series, Special publications, Extension pamphlets and distributed to SAUs, State Fisheries Departments and coastal KVKs involved in brackish water aquaculture activities.</p> <p style="text-align: right;">CIBA, Kochi</p>
		<p>Technologies developed by NIANP are listed and updated.</p> <p style="text-align: right;">NIANP, Bengaluru</p>
		<p>The list of technologies developed has been already submitted to South zone ZTMC, Cochin. The compilation will be done by them since they receive the information from all the Institutes.</p> <p style="text-align: right;">PD ADMAS, Bengaluru</p>
		<p>Technology inventory from SAUs of Zone VIII was compiled and being updated.</p> <p style="text-align: right;">ZPD, Bengaluru</p>
		<p>An updated compilation of results of front line demonstrations and technologies for increasing the production of small millets in India has been brought out in the year 2011</p> <p style="text-align: right;">AICSMIP, Bengaluru</p>

No.	Action Point	Action Taken
		<ul style="list-style-type: none"> • Forage Production Technologies have been developed for Tamil Nadu, Coastal Western Ghats, South zone and semiarid region of Karnataka • Seed treatment schedules for cowpea, berseem, lucerne, stylos, sorghum, pearl millet and maize and grasses for managing insect pests and diseases have been standardized • Integrated Pest Management practices have been developed for, leaf hoppers, weevil and aphid in lucerne and insect-pests of cowpea. <p style="text-align: right;">IGFRI, Jhansi</p>
3	Farmers to be imparted training to produce their own seeds of self-pollinated varieties and distribution of such seeds among the farmers to be encouraged (SAUs).	<p>1. Training programmes on scientific seed production to the farmers were conducted directly by KAU and through the Department of Agriculture. Selected farmers were grouped into SHGs.</p> <p>2. Farmer participatory seed production programmes in the farmers' fields are being taken up in rice and vegetables by KAU. Seed village concept has been introduced in the state for the purpose through the Department of Agriculture. This has been facilitated through trainings of SAUs, ATMA and KVKs. Emphasis will be given to training of Registered Seed Growers.</p> <p style="text-align: right;">KAU, Thrissur</p> <hr/> <p>Under seed village concept, farmer's participatory seed production programme is being implemented. Farmers are being trained for production of self-pollinated crops through National Seed Project. KVKs are conducting farmers training programmes on techniques of seed production in self-pollinated crops. This practice is already in vogue.</p> <p style="text-align: right;">UAS Bengaluru</p> <hr/> <p>Under "Seed Village" concept, farmers are being trained to produce the seeds of self-pollinated crops varieties and these seeds are distributed among the needy farmers.</p> <p style="text-align: right;">UAS Dharwad</p> <hr/> <p>The farmers of this region are being imparted training and breeder seeds supply for one acre under Seed Village Programme regularly to produce their own seeds. During 2010-11, the farmers have produced truthfully labeled seeds of pigeon pea {1493 q}, groundnut (100 q), paddy {1960 q}, sunflower (10 q), bajra (10 q), greengram (10 q), safflower (5 q), daincha {30 q} & sunnhemp (20 q).</p> <p style="text-align: right;">UAS, Raichur</p> <hr/> <p>During 2010-11, about 250 farmers were given training to produce seeds of drumstick, onion and planting material of turmeric, ginger & banana for distribution among the local farmers</p> <p style="text-align: right;">UHS, Bagalkot</p>

No.	Action Point	Action Taken
		<p>1. State level mega seed production programmes have been organized with support of National Agricultural Development Programme to promote certified seeds and increase adoption of quality seeds. All the Agricultural Research Stations of TNAU have been empowered to produce and promote quality seeds especially for paddy and pulse crops.</p> <p>2. Seed Village programmes have also been organized at all TNAU KVKs to impart training on seed production to selected farmers to encourage them for production of quality seeds especially for self-pollinated crops like paddy, groundnut, black gram and green gram.</p> <p>3. All the KVKs are organizing Seed production training programmes for the benefit of farming community. KVKs are also producing quality seeds using revolving funds and distribute quality seeds to farming community of the concerned districts.</p> <p style="text-align: right;">TNAU, Coimbatore</p>
		<p>Public Private Partnership (PPP) model project has been initiated at KVK, Namakkal under the Centrally sponsored feed and fodder development schemes. And fodder crop seeds such as Sorghum, Maize, Cowpea, Guinea grass, <i>Chenchrus</i> grass, Stylo and <i>Desmanthus</i> are produced by 19 progressive farmers and supplied to the needy farmers. Following the success of this scheme, the Department of Animal Husbandry has entered into MoU with KVK, Namakkal for producing fodder crop seeds through progressive farmers and to supply the same to Dept. of Animal Husbandry, Tamil Nadu Dairy Development Corporation (Aavin) and farmers.</p> <p>During the year 2010-11, 18 on campus and 34 off campus training programmes on fodder production were conducted by the Centres of this University benefiting 323 and 843 farmers respectively to produce their own seeds / fodder.</p> <p style="text-align: right;">TANUVAS, Chennai</p>
		<p>Trainings are being organized to produce the quality seed by the farmers under the Project "Seed Production in Agricultural Crops" in all the 56 centres including ICAR Institutes as well as SAUs.</p> <p style="text-align: right;">ADG(CC) ICAR, New Delhi</p>
4	A variety of machinery and farm implements have been developed, but many of them have not reached the farmers. A detailed inventory of available machinery should be compiled.	<p>A detailed District-wise compendium of sugarcane machineries available and the requirement by the farmers was prepared after village level and block level assessment. Adequate funds were also provided under National Agricultural Development Programme – Precision Farming for the conduct of farmers training and publicity so as to create awareness on latest technologies and farm machineries available for sugarcane crop. In this regard, Chief Engineer</p>

No.	Action Point	Action Taken
	Prototypes of the improved machinery are to be made in large numbers with subsidy. Adequate funds should be made available for promoting and publicity of farm machinery developed by research institutions (State Agricultural Departments).	(Agriculture Engineering Department) is also addressed on 5.6.2010 and the reply is awaited. DoA, Tamil Nadu
		The list of machinery and farm implements available in Kerala is enclosed. An amount of Rs. 3.00 crores has been allotted to KAU under the scheme "Innovative Farm Mechanization" from which prototypes of machineries can be developed and publicity can be made. DoA, Kerala
		The list of farm implements included under subsidy programme is enclosed. Sugarcane Stripper, Sugarcane Harvester, Sugar cane Thrash Cutter, Sugar Cane Juice Making Machine and Sugarcane Crusher Units are few farm implements which are helpful for mechanization in sugarcane cultivation. 50% subsidy is being provided to the farmers for the purchase of farm implements based on the lowest quoted price. DoA Karnataka
		Subsidy / assistance is being extended to all the available farm machineries and improved agricultural implements namely, Tractor, Mini Tractor, Paddy Transplanter, Power Tiller, Power Weeder, Rotavator, Seedling machine, Reapers, Thresher, Winnowing, Chain Pulley Block, Cultivator / disc, Cage Wheel and Nursery trays except Combined paddy harvester and sugarcane harvester. Wider publicity is also being given to the farmers through mass media to avail the subsidy benefits provided by this Agricultural Department. DoA Puducherry
		The University is making all efforts to commercialize the farm implements developed by it by involving private entrepreneurs. NRDC is also assisting the University in this endeavour. UAS Bengaluru
		Twenty one improved farm implements / equipments have been developed at various research stations. Attempts will be made to popularize these implements equipments through large scale demonstrations in farmers' fields and training programmes. UAS Dharwad
5	Kerala State Animal Husbandry Department may implement the FMD vaccination regularly, twice a year as prescribed to contain FMD in the State (Animal Husbandry Department, Kerala).	<i>ATR not received</i>

No.	Action Point	Action Taken
6	The new Universities being established now may set a benchmark for the current productivity in major crops so that after 10 years, the impact of the University on productivity can be assessed (SAUs).	<p>The bench mark survey of productivity assessment is being continued by ToT centres under IFS project and this will be extended to other Projects / Directorates.</p> <p>The productivity levels of major crops in 7 districts coming under the jurisdiction of U.A.S., Dharwad have been documented and district Level Contingency plans prepared. These values can serve as bench mark to assess the impact of University in future years.</p> <p style="text-align: right;">UAS, Dharwad</p>
		<p>Noted for future guidance</p> <p style="text-align: right;">UAS, Bengaluru</p>
7	Species-specific feed to be developed for cultured fisheries. Breeding technologies for ornamental fishes need to be developed (Institutes, SAUs).	<p>CIBA has developed feed for shrimp, crab and fishes for nursery and grow out culture. Shrimp and fish feed are commercialized. Breeding of brackish water ornamental fish Scat has already been achieved.</p> <p style="text-align: right;">CIBA, Chennai</p>
		<p>CMFRI had developed a fish feed for marine ornamental fish feed called VARUNA.</p> <p style="text-align: right;">CMFRI, Kochi</p>
		<ol style="list-style-type: none"> 1. A combination diet of trash fish along with pelleted feed was found to be an efficient diet for achieving better growth and production of mud crab under culture condition. 2. Mollusc meat (clam & squid) was seen to be ideal diet for berried mud crabs in hatching tanks. 3. Captive breeding technology was developed for eleven prioritized species of indigenous ornamental fishes. <p style="text-align: right;">KAU, Thrissur</p>
		<p>Two centres of the University at Hesaraghatta and Hebbal Bangalore have developed appropriate breeding technologies for ornamental fishes.</p> <p>The KVAFSU has been working on species-specific fish feed development. Specific feed for fishes like Loaches and for aquarium fishes have been developed by KVAFSU, Bidar.</p> <p>Till date, more than 40 indigenous aquarium fishes have been identified and of these 16 have been successfully bred. The University is in a position to transfer the technology and regular training programmes on ornamental fish production are being conducted.</p> <p style="text-align: right;">KVAFSU, Bidar</p>
		<p>Breeding protocol for 28 varieties of ornamental fishes representing both live and egg bearers that could be adopted by the rural ornamental fish producers has been developed by the</p>

No.	Action Point	Action Taken
		Inland Fisheries Unit, UAS (B). Further, these protocols are being main-streamed through self help group women folk involved in rural ornamental fish production. Formulation of fish feed for seed rearing and grow out fishes representing Indian major carps and exotic carps is in progress UAS, Bengaluru
8	Plant species suitable for biodrainage to be recommended for waterlogged areas (SAUs).	Research work on identifying plant species suitable for bio-drainage for water logged areas will be taken up at ZARS, Mandya under RKVY project to be sanctioned shortly. UAS, Bengaluru
		1. <i>Eichhornia crassipes</i> and <i>Cyperus pangorei</i> can be used as good phyto-extractors for aluminium and heavy metals for bioremediation of inorganic contaminants of rice based wetland ecosystems of Kuttanad, Kerala. The fungi, <i>Trichoderma viridi</i> and <i>Pseudomonas fluorescens</i> could synergize the heavy metal extraction by plants from soil. This technology can be successfully utilized for the purifying heavy metal loaded effluents. 2. A research project entitled "Evaluation of aquatic pollution and identification of phyto remediators in Vellayani lake" is in progress. KAU, Thrissur
		Tree species suitable for bio drainage to be recommended for saline water logged soils are as follows: 1. <i>Acacia nilotica</i> 2. <i>Hardwickia binata</i> 3. <i>Casuarina equisetifolia</i> 4. <i>Acacia feruginia</i> 5. <i>Glyricidia maculata</i> 6. <i>Albizia lerbbeck</i> 7. <i>Pongamia pinnata</i> 8. <i>Inga dulse</i> 9. Eucalyptus Hybrid. UAS, Dharwad
		Eucalyptus (<i>Eucalyptus sp.</i>), Red wood (<i>Sequoia semperuirens</i>), Apricot tree (<i>Prunus armeniaca</i>), Black willow (<i>Salix nigra</i>), Salt cedar (<i>Tamarix andossowil</i>) White mulberry (<i>Morus alba</i>), True date palm (<i>Phoenix dactylifera</i>), Bottle brush (<i>Caillistemon viminalis</i> & <i>C. lanceolatis</i>), Silk oak (<i>Grevillea robusta</i>), Birch (<i>Betula occidentalis</i>) Tulip tree (<i>Liriodendron tulipifera</i>), Jujube (<i>Zizipium jujube</i>), Acacia (<i>Acacia iaufolia</i>), Pine tree (<i>Pinus torreyana</i>), Myrtle (<i>Myrtus communis</i>), Senna (<i>Cassia tomentosa</i>) Acacia (<i>Acacia nilotica</i>), Seemai karuvel (<i>Prosopis juliflora</i>), Pungam tree (<i>Pongamia pinnata</i>), Chawk (<i>Casurina equeustifolia</i> & <i>C. junquniana</i>), Weeping willow (<i>Salix banilonica</i> and <i>S. alba</i>) are suitable for bio drainage for water logged areas. TNAU, Coimbatore
9	The germplasm available with SAUs may be accessioned with NBPGR	The germplasm available with KAU is being accessioned with NBPGR. KAU, Thrissur

No.	Action Point	Action Taken
	immediately (SAUs)	<p>The germplasm of 21 crop varieties including both parental lines and hybrids of sunflower, paddy and cowpea have been accessioned with NBPGR and action is being taken to access the remaining varieties with NBPGR.</p> <p style="text-align: right;">UAS, Bengaluru</p>
		<p>The concerned breeders have been informed to deposit the germplasm maintained at their centers to the NBPGR immediately.</p> <p style="text-align: right;">UAS, Dharwad</p>
		<p>The Directors of Research of KAU, TNAU, UAS-Dharwad, UAS-Bangalore, UHS-Bhagalkot, UAS-Raichur and Dean, PAJANCOA were requested to submit germplasm for accessioning and conservation by NBPGR, New Delhi. In 10 proposals, seeds of 19 new varieties of rice (6), grain cowpea (2), ginger (2), tomato (2), okra (2), yard-long bean (1), bird-chilli (1), chilli (1), bitter gourd (1) and snake gourd (1), to be released by the State Varietal Release Committee, Kerala were received and the proposals were processed for accessioning and conservation by NBPGR and IC numbers assigned, germplasm conserved and allotted IC numbers informed to the proposer(s). Similarly, seeds of released varieties from TNAU, UAS-Bangalore and UAS-Dharwad were directly sent by the SAUs to GCD, NBPGR, New Delhi for accessioning and conservation.</p> <p style="text-align: right;">NBPGR, New Delhi</p>
		<p>The details of the active germplasm collections available at TNAU has been documented as per the prescribed format in excel files and it has been sent to the Director, NBPGR, Pusa Campus, New Delhi -110 012.</p> <p style="text-align: right;">TNAU, Coimbatore</p>
		<p>A letter to all the ICAR Institutes and SAUs has already been issued regarding submission of germplasm with the NBPGR and to get the accession numbers.</p> <p style="text-align: right;">ADG(CC), ICAR, New Delhi</p>
10	Comprehensive “package of practices” are to be brought out for each State / agro-climatic region integrating the recommendations of SAUs and the ICAR Institutes (SAUs, Institutes).	<p>POP (Crops) is an authentic record that compiles the technologies of SAUs and ICAR institutes in the State and is updated periodically through a workshop arranged for the purpose. The latest edition of POP is under preparation and will be released soon.</p> <p style="text-align: right;">KAU, Thrissur</p>
		<p>Officials of Line Departments and Scientists of the ICAR institutes are being invited in developing package of practices and thereby there is integration in recommendations of SAUs and ICAR Institutions.</p> <p style="text-align: right;">UAS, Bengaluru</p>

No.	Action Point	Action Taken
		<p>Comprehensive "PoP" is brought out by UAS, Dharwad based on agro-climatic concept and recommendations of ZREAC and ZREPC workshops in Kannada. The 'PoPs' are available in Agri., Hort. & Livestock Management.</p> <p style="text-align: right;">UAS, Dharwad</p>
		<p>The UAS, Raichur and Dharwad are jointly bringing out comprehensive package of practices for the agro-climatic region.</p> <p style="text-align: right;">UAS, Raichur</p>
		<p>UHS, Bagalkot has prepared a draft copy of the package of practice for Horticultural crops. It will be placed before the joint committee involving all Farm Universities and ICAR institutes of the state and published.</p> <p style="text-align: right;">UHS, Bagalkot</p>
		<ol style="list-style-type: none"> 1. TNAU has developed comprehensive Agritech Portal (www.agritech.tnau.ac.in) which contains Package of Practices of all the Major and Minor Crops by incorporating SAUs and ICAR varieties and technologies. 2. Tamil Nadu State Government and TNAU are publishing Crop Production Guide for Agriculture as well as Horticulture every year by incorporating TNAU & ICAR varieties and technologies agro-climatic zone-wise and distributing to all Agri. Extension Officials for follow up. 3. Directorate of Extension Education, TNAU has published District Specific Technology Inventory for Tamil Nadu and Puducherry by including SAUs and ICAR technologies, district-wise and zone-wise and distributed to all KVKs and Agricultural Extension officials. <p style="text-align: right;">TNAU, Coimbatore</p>
		<p>A book on 'Package of practices for cane cultivation' integrating the recommendations of SBI and TNAU is under preparation and is in the final proof stage</p> <p style="text-align: right;">SBI, Coimbatore</p>
		<p>Efforts have been taken to prepare comprehensive "Package of Practices" for each agro climatic zone integrating the recommendations of SAUs. Multi location trials involving the SAUs and Departments are being conducted to bring out the location specific technologies for inclusion in the "Package of Practices". Package of practices of some states have been listed in our institute website.</p> <p style="text-align: right;">CICR RS, Coimbatore</p>
		<p>Based on the inputs given by the AICRP on Biocontrol, package of practices for the respective states will be finalized by the SAUs. The AICRP partners of the SAUs have been given clear instructions to ensure this activity</p> <p style="text-align: right;">NBAII, Bengaluru</p>

No.	Action Point	Action Taken
		<p>Comprehensive publications entitled, "Wealth of Ornamental Crops - Varieties Developed at IIHR" and "Production Technology of Vegetables - A Hand Book" have been released. A similar publication on Fruits will be brought out shortly.</p> <p style="text-align: right;">IIHR, Bengaluru</p>
		<p>Technologies have been made available to bring out comprehensive "Package of Practices" for each State / agro-climatic region as and when required.</p> <p style="text-align: right;">DCR, Puttur</p>
		<p>Till now, the SAUs were bringing out the package of practices for spices incorporating the technologies developed by IISR, Calicut. Hereafter, steps will be taken to collect the recommendations of SAUs through AICRP on Spices and incorporate them and bring out the package of practices.</p> <p style="text-align: right;">IISR, Calicut</p>
		<p>Efforts were made for integrating the recommendations of CPCRI in the publication on package of practices brought out by Kerala Agricultural University for Kerala State. Such efforts would be made for integrating the recommendations of other Agriculture Universities representing the States where mandate crops (palms and cocoa) are grown.</p> <p style="text-align: right;">CPCRI, Kasaragod</p>
		<p>This is already in vogue in Kerala by bringing out the package of practices recommendations by KAU</p> <p style="text-align: right;">CTCRI, Trivandrum</p>
		<p>Package of Practices for banana cultivation has been brought out. Different technical / extension bulletins, folders relating to the technological inventions made by the Centre have been brought out in English, Hindi and vernacular Tamil.</p> <p style="text-align: right;">NRC Banana, Trichy</p>
		<p>Based on location specific on-farm demonstrations, package of practices are brought out for dissemination to aqua farmers.</p> <p style="text-align: right;">CIBA, Chennai</p>
		<p>Necessary inputs from NIANP will be provided in this regard.</p> <p style="text-align: right;">NIANP, Bengaluru</p>
		<p>The compilation of comprehensive package of practices is in progress and is expected to be published by year end.</p> <p style="text-align: right;">IGFRI, Jhansi</p>

No.	Action Point	Action Taken
		<p>The package of practices in Animal Husbandry and Fisheries is periodically reviewed and published in consultation with Department of Animal Husbandry & Fisheries Karnataka and made available to the farmers at subsidized prices</p> <p style="text-align: right;">KVFASU, Bidar</p> <hr/> <p>Technologies for production and productivity improvement of different food and fodder crops are being updated regularly in the package of practices published by the SAUs and ICAR from time to time and is available in English and vernacular language of particular State.</p> <p style="text-align: right;">ADG (CC), ICAR, New Delhi</p>
11	Information on Nutrient profile of minor millets should be updated and published. Studies are to be taken up on the Nutrient profile of recent varieties of minor millets (SAU, AICRP on minor millets).	<p>Minor millets are crops of dry areas and have very little significance in a high rainfall state like Kerala.</p> <p style="text-align: right;">KAU, Thrissur</p> <hr/> <p>Core set of finger millet germplasm, rich in protein and zinc is published. All released and pre-release small millet genotypes have been given to CFTRI, Mysore for nutrient profiling.</p> <p style="text-align: right;">UAS, Bengaluru</p> <hr/> <ul style="list-style-type: none"> • Varietal screening of barnyard millet (9 varieties) for nutrient composition, IVSD IVPD and dietary fiber. • Screening of little millet and Foxtail millet for nutrient composition - Sukshema and local variety of little millet were analysed for nutrient composition and antioxidant profile of land races of Karnataka will be analysed. • Under NAIP, 280 land races of little millet and 750 foxtail millet samples collected from farmers' fields will be analysed for proximate principles, minerals, dietary fiber, polyphenols and other nutraceutical components. <p style="text-align: right;">UAS, Dharwad</p> <hr/> <p>The information on the nutritional qualities of the recently released small millet varieties along with the latest checks is available. They will be updated and compiled and will be published soon. After publication, a copy will be submitted.</p> <p style="text-align: right;">TNAU, Coimbatore</p>

No.	Action Point	Action Taken
		<p>Finger millet and other small millets, widely grown in semi arid areas, are staple food crops for millions of poor and highly digestible and nutritional fodder crops for cattle in drought prone areas. Nutritionally finger millet is an excellent source of calcium and methionine which is lacking in diets of millions who live on rice and other millets have more fibre, protein, iron, manganese. A preliminary project proposal for establishment of nutritional laboratory at AICSMIP GKV, Bangalore (for all the 14 AICRP centres) is being prepared.</p> <ul style="list-style-type: none"> • Nutritional analysis of released and pre-released varieties was carried out at CFTRI during 2010-11. The fat content is distinctly lower (0.63%) in finger millet compared to other small millets. The protein content was highest (16.3%) in proso millet with lower carbohydrate content. • For nutritional analysis of finger millet 230 accessions that include varieties, land races and a mini-core are raised at four geographical locations including Bangalore. Grain has been collected for further analysis. • Establishment of Atomic absorption spectrophotometer for estimation of minerals is in progress. <p style="text-align: right;">AICSMIP Bengaluru</p> <p>The nutrient profile in the fodder of minor millets is being assessed for its nutritive quality by the KVAFSU to feed the livestock and the same will be published. Further under centrally sponsored fodder scheme two additional Labs at Bangalore and Bidar are being upgraded and renovated</p> <p style="text-align: right;">KVFSU, Bidar</p>
12	There is need for greater attention on Sericulture research especially on Moriculture as this activity helps to generate more income and gainful employment for farmers. This could also be integrated with dairy farming (SAUs, NDRI-Bengaluru).	<p>Studies on sustainable technology for higher productivity in mulberry showed that cultivation of mulberry under open condition in paired rows with cowpea as green manure intercrop resulted in higher leaf yield, leaf quality and higher income.</p> <p style="text-align: right;">KAU, Thrissur</p> <p>A research project proposal has been submitted to the GOK under RKVY for funding to take up sericulture research. Presently sericulture is not included in ICAR research domain. Sericulture being an important economic activity in some states, it should find a place in ICAR system to enable universities to get adequate financial support to carryout research in this area.</p> <p style="text-align: right;">UAS, Bengaluru</p> <p>UAS, Dharwad has collected more than 30 south Indian popular mulberry cultivars suitable for medium black soils. To exploit sericulture which is one of the profitable enterprises, as a part of integrated farming system to earn additional income, there is a great scope for sericulture research in this zone.</p> <p style="text-align: right;">UAS, Dharwad</p>

No.	Action Point	Action Taken
		<p>Research has been carried out on identification of suitable mulberry varieties, silkworm races, pest and disease management in mulberry and silkworm, by-product utilization, tissue culture mulberry for stress tolerance, amylase based selection of silkworm races, probiotics for silkworm diseases etc. In addition, technologies such as IPM packages for leaf webber; and papaya mealy bug, Phytojuvenoid compound for silkworms; TNAU Seridust for rearing bed disinfection and IPM package for management of pest and diseases of silkworm have been released to farmers for adoption. Works have been initiated to integrate sericulture with other farm related activities. Steps will be taken to find out possibility of integrating with dairy farming.</p> <p style="text-align: right;">TNAU, Coimbatore</p>
		<p>KVAFSU has assessed the nutritive value of silk worm pupa meal as poultry feed. It is being used at 10% of the diet and has been found to decrease the cholesterol level in chicken meat. This meal is being assessed for feeding the dairy cattle with the concept of integrated farm system. Similarly the mulberry leaves feeding has resulted in beneficial effects in rabbitry and sheep husbandry.</p> <p style="text-align: right;">KVAFSU, Bidar</p>
		<p>Work on the aspect will be taken in our research farms.</p> <p style="text-align: right;">TANUVAS, Chennai</p>
		<p>About 2 lakh ha in Karnataka and Andhra Pradesh is under mulberry cultivation. Sericulture activity results in significant quantities of secondary and waste products. This waste can be utilized for feeding by mixing with straw and other feed materials. In this direction the following action has been initiated,</p> <p>(i) To develop appropriate feed formulations utilizing the mulberry wastes in co-ordination with Central Silk Research Institute, Mysore.</p> <p>(ii) To incorporate waste mulberry in the production of complete feed block for effective utilization.</p> <p style="text-align: right;">NDRI, Bengaluru</p>
		<p>The residual mulberries are fed to the cattle by mixing with other feeds upto a level of 10% in the milk producing areas. However, it has been observed that feeding at higher level results in reproductive complication. A pilot project on this is in progress at Southern Regional Station, NDRI, Bangalore in association with Central Sericulture Research Institute.</p> <p style="text-align: right;">Animal Sciences Division, ICAR, New Delhi</p>

No.	Action Point	Action Taken
13	Fodder Development Programme may be entrusted to the Agricultural Departments of the States since the Animal Husbandry departments do not have the expertise on the cultivation of fodder crops. There is a need for establishing feed block warehouses (Departments of Agriculture and Animal Husbandry).	Fodder development programme is being looked after by Animal Husbandry Department in Tamil Nadu. Agriculture Officers from Agriculture Department are working in the Animal Husbandry farm on deputation. So expertise is available in Tamil Nadu with Animal Husbandry Department. DoA, Tamil Nadu
		Presently fodder development is not undertaken by Department of Agriculture. In Kerala, Dairy Development Department is promoting programmes for the development of fodder cultivation in the state. DoA, Kerala
		The Animal Husbandry Department has got the expertise on cultivation of fodder crops and is implementing the Accelerated Fodder Development programme under RKVY during 2011-12. In this programme the main thrust is fodder seed production and providing fodder mini kits to the farmers. The Agricultural universities are also involved in the implementation of this scheme. The scheme includes activities like planting perennial fodder on bunds, border fodder plantation, fodder nursery etc. DoA, Karnataka
		At present, the Fodder Development Programme is entrusted to the Department of Agriculture, Puducherry and this Department is now operating a scheme to increase the area under fodder crops by extending back -ended subsidy @ Rs. 5000/acre to the individual farmers or Self Help Groups (SHG's), involved in the cultivation of improved fodder varieties. DoA, Puducherry
14	A team from ICAR will visit the state capitals and interact with the line departments under the Chairmanship of the Chief Secretary to sensitize the state bodies on various issues related to agriculture and allied sectors. The DDG in charge of the region will facilitate these meetings and spend one day in the Secretariat and one day in the field along with the stakeholders (DDG Extn.).	The ICAR peer review committee and State government's Expenditure Reforms committee have visited the University and reviewed the progress and also have made field visit to the LRIC, Deoni KVFASU, Bidar
		University will facilitate in organizing the proposed meeting with the State Government. UAS, Bengaluru

No.	Action Point	Action Taken
15	Student exchange programme between States and Universities should be thought of and the incentive mechanism should be worked out by the Universities.	NTS is awarded as an incentive to the students who opt States other than their domicile. However, the recommendation is noted for further amplification in XII Plan. Education Division, ICAR, New Delhi
		This point was discussed in the high Power consultative meet on Agricultural Education organized at UAS Bangalore on 19 th and 20 th January 2011. The recommendations of the High power committee is awaited UAS, Bengaluru
		Discussions on the exchange UG and PG students of different faculties and disciplines, among different universities within the state and also between states are in progress. UAS, Dharwad
		As per the regulations of VCI, there is a provision for intra university migration to the students and the same is being implemented by the university in specific cases. Under UMN-KVAFSU Tata clinical internship training programme, students of Veterinary College get 3 months advanced training at University of Minnesota, USA. Under KVAFSU-Perdue Afghan programme, Post Graduate students of Veterinary Science of Afghanistan get higher training at KVAFSU, Bidar. KVAFSU, Bidar
		The students exchange programmes between SAUs / Veterinary Universities are suggested in the P.G. / Ph.D. levels. The student beneficiaries during the exchange period shall be paid stipends / scholarships / fellowships to the tune as per the emoluments of SRF and RA working in ICAR funded schemes. The conditions and procedures for the exchange shall be determined by a separate document. Further in order to achieve the objectives and carry out the agreed action under the programme, the University shall be provided with adequate funding to meet out the Recurring Contingency expenses on a regular basis and for purchase of essential equipment. TANUVAS, Chennai
16	Participation of State officials in the regional committee meeting is less compared to central/ICAR officials. This hampers effective dialogue. State officials at the level of Dy. Directors/Asst. Directors	The participation of state officials and progressive farmers has been ensured by KVAFSU duly placing them as member of Academic, Research and Extension council in addition to region specific meetings. Further periodical interaction is happening through short term refresher training courses under Continuing Education programme for the officials of Dept. of AH&VS, KMF and Fisheries. KVAFSU, Bidar

No.	Action Point	Action Taken
	also may be invited to Regional Committee Meeting. Few progressive farmers also should be invited. Also to include representatives from soil conservation, seed corporations, sericulture Dept., wasteland management Board, Watershed Management.	The University endorses this view. This is being practiced by the University, where invitation is being extended to officers of Line Department and progressive farmers to attend research and Extension council meetings. UAS, Bengaluru
		The Joint Directors of the line Departments at Coimbatore have been invited for the meeting. All the officials will be invited for the proposed hub meeting. Secretary, Regional Committee
17	Action plan on Solid waste management, waste water management and recycling to be developed (SAUs).	<ul style="list-style-type: none"> Started PG Diploma course in solid waste management during the year 2011 - 12. "Thumburmuzhi Aerobic Composting Technique", a rural innovative method in livestock waste management was developed and tested successfully. A bacterial isolate identified as <i>Bacillus subtilis</i> was found effective for degrading lignin, cellulose and starch under <i>in vitro</i> condition and the efficiency was checked under field condition. A pilot plant for the management of solid wastes will be set up in the Ladies Hostel of the College of Horticulture and toxicological evaluation of the bacterial isolate will be carried out. Validation of these bacterial inoculants under field conditions in Thrissur corporation area was sanctioned under the ATMA Scheme. Excellent reduction (about 90%) in TSS, BOD, Total N, PO₄ and TC was observed in Grey water by treatment using sub-surface flow constructed wetland. KAU, Thrissur
		Research proposal on waste water recycling solid waste has been submitted for funding under RKVY. UAS, Bengaluru
		The following solid waste management programmes have been under taken. <ul style="list-style-type: none"> Use of copper and gold ore tailings in Agriculture Use of fly ash and sewage sludge in agriculture Utilization of distillery waste-spent wash in Agriculture Conjunctive use of poor quality water UAS, Dharwad
		<ul style="list-style-type: none"> Technology for composting of solid wastes such as coir pith, weeds and commercially non utilized plants has been standardized.

No.	Action Point	Action Taken
		<ul style="list-style-type: none"> • TNAU vermin Biocompost Technology for degradation of organic wastes by earthworm has been developed and made available to the farmers. • Techniques for industrial waste utilization for land reclamation and crop production have been standardized. • Crops and varieties suitable for tannery waste affected soils have been identified. • Techniques for reclamation of paper mill effluent irrigated soil and for waste water management are also available and are recommended to the farmers. <p style="text-align: right;">TNAU, Coimbatore</p> <ul style="list-style-type: none"> • The waste water of the dairy at University Research Farm, Chennai is collected, solids separated and the remaining waste water is used for irrigation purpose after dilution with ordinary water resulting in improved yield. Training on this aspect is being given to the farmers of nearby areas. • A Deenabandu model, 4 m³ capacity biogas plant is functioning with the use of cow dung and swine faecal materials at VC&RI, Namakkal. • The biogas sludge and other solid waste like manure, bedding material are being composted and utilized for fodder cultivation at all the research farms of TANUVAS. • The liquid waste from cattle and piggery unit like urine and wash water are collected in a sedimentation tank and the solid portion is removed for compost making. The liquid waste is utilized for Azolla cultivation and the surplus water is then utilized for fodder cultivation at VC&RI, Namakkal. • A Carcass utilization plant is functioning at VC&RI, Namakkal which recycles the dead poultry birds and other livestock carcasses to produce meat meal, bone meal and rendered fat. <p style="text-align: right;">TANUVAS, Chennai</p>
18	Agro-forestry models customized to Karnataka	<p>The Research work on Agro-forestry model is in progress.</p> <p style="text-align: right;">UAS, Bengaluru</p>

No.	Action Point	Action Taken
	State may be developed (SAUs, Chief conservator of forests, Karnataka).	<p>Long term experiments under AICRP on Agroforestry are concluded. The following agroforestry systems are found suitable:</p> <ul style="list-style-type: none"> • Sapota Teak based agroforestry system (hill zone) • Horti-silvi pastoral system (hill zone) • Teak based agroforestry system (transitional zone) • Mixed cropping tamarind and erect growing tree species <p>Attempts to popularize the above agroforestry systems in the concerned agro climatic areas of the state are in progress.</p> <p style="text-align: right;">UAS, Dharwad</p>
19	The Mangalore KVK is to be transferred to KVAFSU.	<p>The Mangalore Krishi Vigyan Kendra has already been transferred to KVAFSU, Bidar on 30-08-2011</p> <p style="text-align: right;">KVFSU, Bidar; ZPD, Bengaluru; UAS Bengaluru</p>
20	NIANP and IGRI and other Institutions should jointly evolve a model for dry and green fodder production in the region	<p>Models for dry and green fodder production in Rainfed - arable lands, Rainfed - Non arable lands, Irrigated - arable lands and Irrigated - non-arable lands for the region covering Karnataka, Kerala, Tamil Nadu and UT of Puducherry & Lakshadweep Island-</p> <p style="text-align: right;">IGRI, Jhansi</p> <p>University will also associate research activities undertaken by these institutes in evolving model for dry and green fodder production</p> <p style="text-align: right;">UAS, Bengaluru</p> <ul style="list-style-type: none"> • A meeting was convened at NIANP in which officials from IGRI Regional Station, Dharwad, Central Fodder Seed Production Farm, Bengaluru, Karnataka Milk Federation and AH&VS Dept. of Karnataka p to discuss the various issues related to fodder development programme in Karnataka. The following five points emerged out of the meeting: • The grant of Rs 50 lakhs by GOI to KMF under the revolving fund scheme on fodder seeds multiplication need to be effectively utilized for multiplication of fodder seeds through different milk unions of Karnataka. • To make the above programme successful, IGRI Research Centre, Dharwad has agreed to provide quality seeds of four fodders crops viz. Lucerne, Guinea grass, perennial sorghum and Hybrid Napier (50 kg of each variety). KMF is presently procuring seeds of African Tall variety from NSC Bangalore and Gujarat State. , • The Karnataka Milk Federation agreed to work out the actual total fodder seed requirement for the state for better planning.

No.	Action Point	Action Taken
		<ul style="list-style-type: none"> • There is a pressing need to provide one seed processing plant along with warehouse / silo facility for the storage of fodder seeds in each milk union. The GOI needs to make some provision for financial KMF, Bangalore will prepare a detailed project report for taking up this matter at a higher level for necessary funding. • Govt, of Karnataka has allotted 50 acres of land at Koyla village to Dakshina Kannada Milk Union and another 100 acres of land at Hessarghatta village to KMF for fodder seeds' development. However, these agencies require sufficient financial assistance to bring these fields under cultivation by taking up the works like clearance of trees, fencing providing irrigation facilities, land development etc. • The Joint Director, KMF Bangalore is entrusted with the responsibility to prepare a detailed project report for getting the necessary funding. <p>In addition to the above, NIANP, Bengaluru has been undertaking the following activities:</p> <ul style="list-style-type: none"> • Training programmes for dairy farmers regarding use of improved varieties of fodder crops and their production practices at KVKs of Hadonahalli and Babbur farm and in the villages of Chitradurga district. • Procurement of seeds of improved varieties of fodder crops like lucerne, maize and Sorghum from IGFRl, Dharwad and CFSP Farm, Bengaluru and conducted demonstrations in both kharif and rabi seasons at the farmers; fields in different villages as well as KVK farms to create awareness among the dairy farmers. • Popularization of cultivation of Azolla as supplemental fodder by conducting over 75 demonstrations in various villages. More than 100 farmers adopted this practice and are feeding Azolla to their livestock. <p style="text-align: right;">Animal Sciences Division, ICAR, New Delhi</p>

CHAPTER III

DEVELOPMENT ISSUES AND RESEARCH NEEDS

TAMIL NADU

DEPARTMENT OF HORTICULTURE AND PLANTATION CROPS, TAMIL NADU

Status of varieties of seeds / planting materials released in the last three years.

The following varieties / hybrids are popular and perform well as reported by farming community.

- | | |
|--------------|------------|
| a. COTH 1 | Tomato |
| b. CO 3 | Amaranthus |
| c. COGB 14 | Lablab |
| d. PPI (B)-1 | Brinjal |

Since horticulture farmers are nowadays practicing intensive cultivation, they are mostly cultivating hybrids especially in vegetable crops. The hybrids of private seed companies are a huge hit with the farmers in spite of their high cost. The hybrids released by TNAU are not so popular with farmers. The old varieties like PKM 1 tomato and PKM 1 Annual Moringa are still popular.

The varieties released in the last three years such as COBH2 & VRM 1 brinjal, COTH3 tomato, CO1 chillies hybrid and PLR (SG) 2 snake gourd are not taken well by farmers. The Greens culture A8 selection given by TNAU shows very good performance. This culture Selection 8 may be released as a variety.

Responses to the package of practices to soil or plant nutrient management, plant protection, Irrigation, Agronomy, Agricultural Practices etc.

The following technologies are gaining more field Level importance

- High density planting in mango
- Canopy management in mango
- Precision farming technologies with fertigation techniques
- Micro irrigation with fertigation techniques
- Protray seeding technology for vegetable nursery
- Parasite released to control Papaya Mealy Bug
- Soil application and seed treatment with *Trichoderma viridi* and *Pseudomonas* to control root rot and bacterial diseases.
- GAP followed in mango and banana crops

Assessment of technology and package of practices for reclamation of lands

- Application of gypsum is the only practice adopted successfully by the farmers to control alkalinity in soil.
- Repeated flooding and drainage of irrigation water is practiced by few progressive farmers in saline soils.

Success/failures of new crop rotations /cropping sequences/ mixed cropping etc.

Successes:

- Inter cropping of cocoa in coconut gardens is proved to be successful.

- Inter cropping of banana in coconut gardens is proved to be successful.
- Vegetable - groundnut/pulses – paddy sequence is successful in Kancheepuram district
- In paddy fallow lands, cultivation of hybrid vegetables replacing pulses is becoming popular.
- Intercropping with onion, lablab, pulses and tomato as intercrops in Grand Naine banana is highly successful in Theni district.
- Banana-vegetables-banana crop rotation is successful in Theni district
- Vegetables-maize-pulses crop rotation is successful in Theni district
- Grapes with coccinia or gourds (vegetables) is a success.
- Mixed cropping of onion, tuberose and annual moringa is being practiced in Madurai district

Failures:

- Aonla cultivation in Cumbum Valley
- Vegetable cultivation in tank-fed areas or immediate to tank area in Kancheepuram district.

Acceptance of processes / products developed and released by TNAU

The following processes and products have been accepted by farmers.

- Coconut tonic and Micro Nutrient Mixtures,
- Trichoderma viridi , Pseudomonas
- Parasites developed for control of mealy bugs
- The shade net cultivation of Tomato (Fertigation within shade net cultivation is not practiced)

Performance of equipments and machinery introduced

The following machinery and equipments introduced are performing very well and widely accepted by the horticulture farming community

- | | |
|------------------|-------------------------|
| 1. Chisel Plough | 7. Motorized sprayers |
| 2. Coffee pulper | 8. Mini-weeder |
| 3. Brush cutter | 9. Tree-pruner |
| 4. Power weeder | 10. Power rotary weeder |
| 5. Mini Tractor | 11. Dry land weeder |
| 6. Chain saw | |

KARNATAKA

DEPARTMENT OF AGRICULTURE

Status of varieties of seeds / planting material released in the last three years.

Details of varieties released / notified during last three years (2009 – 2011)

Paddy	-MAS 946-1(Sharada), ONA SIRI(MAS-26), CSR-22, KHP-10, PUMB-8, MGD 101, IET 14845
Ragi	- ML 365
Cotton	- RAHH-95 (Virajita), RAHB-87 (Yashasvi), RAH-100 (Yugank), DLSA-17
Cowpea	- IT-38956-1, KM-5
Foxtail Millet	- HMT-100-1
Greengram	- Selection-4 Hasirumuthu

Groundnut	- TGLPS-3
Jowar	- NAH 2049, DSV-6
Maize	- KBN-1
Pigeon pea	- BRG-2, WRP-1
Ragi	- Rathna (GPU-48), IET-13901, GPU-67
Greengram	- KKM-3
Groundnut	- GPM-6
Sunflower	- KBSH-53

The varieties listed below were recommended for Notification by GOI. The Notification is awaited.

Finger Millet	- KMR 301
Pigeon pea	- TS-3R
Finger Millet	- DHRS-1

The varieties listed below were deferred for notification due to want of additional information. The required additional information has been submitted to GOI. Notification is awaited.

Maize	- Hema (NAH-1137)
Groundnut	- Chintamani-2(KCG-2)
Rice	- Raksha (KMP 103), Mugad Siri-1253
Finger Millet	- GPU 66
Sesame	- DSS-9
Sunflower	- RSFH-130, RSFV-901

- During the last 3 years though 31 varieties have been released / notified & 8 varieties have been released & notification is awaited, only 3 varieties are in the seed production chain.

Reasons for not bringing the remaining varieties into Seed Chain.

- Government of India is phasing out old varieties & above 10 years varieties are being excluded under subsidy programmes in phased manner.
- Traditional and old varieties in Groundnut, Rabi Sorghum, Gram and many other crops are still popular. Hence the present system has to be continued till suitable new varieties are developed by the State Agricultural Universities / ICAR failing which the farmers will be deprived of the benefits of subsidy programmes.
- Due to non-availability of popular new varieties, the farmers will be deprived of the benefits of the using quality seeds of new varieties resulting in low production
- Though varieties are recommended for notification by the State Seeds Sub-committee, the SAU do not comply with the GOI procedures; hence notification of these varieties by GOI is sometimes delayed by more than 1 or 2 years.

Response to the package of practices to soil and plant nutrient management, Plant Protection, Irrigation, Agronomy, Agricultural practices etc.

Soil health:

Soil and Water are the basic resources of Agriculture. The Soil Testing is one of the basic programmes of Agricultural Department which is necessary to find out the soil fertility status, soil health and available nutrients in order to recommend suitable fertilizers and organic

manures for crop production. There are 28 Soil Health Centres analyzing soil samples of Karnataka for major and micronutrients with an annual target of 2.00 lakh soil samples. All the laboratories are equipped with micronutrient analysis facilities and trained analysts. The samples are drawn from both dry land and irrigated fields season wise. Soil health cards along with fertilizer recommendations are distributed to farmers individually. The package of practice of University of Agricultural Sciences is used to give crop wise recommendation.

Bhoochetana programme was implemented in the state for improving productivity in rainfed agriculture. Soil test based fertilizer recommendation was one of the technological interventions being adopted. During 2009-10 it was implemented in six districts covering 2.25 lakh ha and during 2010-11 it was extended to 16 districts covering 12.75 lakh ha and soil sample analysis was done by ICRISAT. During 2011-12, the scheme has been extended to all remaining districts covering 28.42 lakh ha and 22 lakh farmers and altogether 92,642 soil samples were collected and analysed for pH, EC, N, P, K, S, Zn, Cu, Fe, Mn & B.

In majority of the areas, sulphur deficiency was observed. Along with the major nutrient recommendation, gypsum application was also taken up to overcome sulphur deficiency. Zinc deficiency was observed in 80-90% of the area followed by Boron deficiency to a tune of 50-60%. The deficiencies were addressed by recommending zinc sulphate (21% zinc) and Borax (10.5% boron and 20% boron).

Soil test-based results have proven successful in diagnosing nutrient deficiencies as well as for promoting balanced nutrient management strategy as a pre-requisite for sustainable increase in productivity in rainfed systems. Productivity of rainfed crops has increased by 25-40% in the areas covered under this scheme.

Soil fertility Atlas of Karnataka: Soil fertility maps of 30 districts were prepared and distributed to the districts. The soil health cards along with fertilizer recommendations for major dry land crops were distributed to the individual farmers.

The soil health needs to be assessed on more scientific grounds. The fertilizer recommendations based on soil testing are being given by classifying the soil into low, medium and high category since 1956. In this approach, the norms for fertilizer recommendation followed are the same for crop grown in all types of soil. This needs to be re-evaluated with the changing trend in soil fertility status and improved crop varieties.

In Karnataka, Soil test crop response approach is adopted for site and situation specific recommendations considering the fertilizer use efficiency on particular type of soil and climate. The targeted yield equations for major crops have been developed for major agriculture crops in zones 3, 4, 5, 6 & 7 of Karnataka. However, the STCR approach has not been adopted in Northern Karnataka districts. The targeted yield equations are yet to be developed for major crops grown in zones 1, 2 and 3 of Karnataka.

Plant Nutrient Management: The fertility and productivity of soils in the recent years is on decline owing to high usage of fertilizers without sufficient organic manures. Integrated Nutrient Management is to be followed to maintain soil health. Further building up a national networking arrangement to coordinate the studies on fertilizer use and soil health in different agro climatic regions is needed. Consumption of different fertilizers and NPK for the past three years is in the increasing trend.

Irrigation:

- a) In order to save water, micro irrigation systems like drip irrigation, sprinkler irrigation are to be popularized with more assistance from the Government.

- b) SRI method of paddy cultivation is not becoming popular among farmers. The problems in adoption are to be identified and solved. Modified SRI is being popularised.
- c) Water quality maps: The underground water quality maps are not prepared. Suitable cropping systems are to be recommended based on water quality.

Assessment of technology and package of practices for reclamation of Lands (Saline, Water logged etc.)

Water logged soils: In Karnataka 63,000 ha of land is being affected by water logging and the following management practices are recommended:

- Providing drainage (surface/subsurface) at definite intervals depending on soil texture and slope and draining out excess water.
- Application of more organic and green manure to improve the physical condition of the soil.
- Use of land for fishery purpose if there is a problem of drainage.

Saline / sodic and saline sodic soils: Around 2.5 lakh ha land is being affected by saline/sodic and saline sodicity and the following management practices are recommended:

- Application of gypsum / sulphur based on gypsum requirement of sodic soils and leaching of excess sodium with good quality irrigation water.
- Providing surface/subsurface drainage at definite intervals depending on soil texture and slope and draining of excess salt with good quality irrigation water.
- Application of more green/organic manure to improve soil structure.
- Growing salt resistant varieties like paddy-CSR-22, IR 30864, Rasi
- Judicious use of irrigation water and fertilizers

Performance of Equipments and Machineries introduced

The farming community is facing acute labour problem for agricultural operations mainly during planting and harvesting periods. The labour cost also is increasing every year. So the Department is encouraging the use of farm machinery and high tech farm implements through subsidies. They have become popular among the farming community.

During the year 2011-12, 50% subsidy is provided for the Farm Machineries costing below Rs. 5,00,000) and 40% subsidy for the Farm Machineries costing more than Rs.5,00,000. Ninety percent subsidy is provided for Farm Machineries under Special Component Programme and Tribal Sub Programme. All categories of farm machineries required from land preparation to post harvest are included in the subsidy programme.

Further, majority of the farmers come under small and marginal category and their land holdings are less than two hectares. The age old concept of sharing of farm implements and tools among farmers in a village has been severely eroded. To provide the benefits of mechanization to small and marginal farmers and make them to grow crops profitably, custom hiring the farm machineries and equipment from a nearby custom hire centre is necessary. The latest farm machineries, plant protection equipments and post-harvest equipments should reach the small and marginal farmers, in particular, through organized custom hire service centers to be established at taluk level through registered societies / Self-help groups / Farmer groups. Through these Custom Hire and Service Centres, the small and marginal farmers could utilize farm machineries efficiently and economically to enhance the productivity of crops.

Further, emphasis should also be given for improved bullock drawn implements suitable for sowing such as seed drill for crops like bengal gram, black gram, green gram bajra, sorghum and ragi, and bullock drawn groundnut digger and bullock drawn duster for red gram.

Major Bottle necks in promoting Mechanization

- Lack of standardization of interchangeable and fast wearing spares of critical components of farm equipments.
- Less investing capacity of farmers
- Availability of finance and credit facilities.
- Lack of skilled labour
- Lack of research and development in the field of Farm Mechanization.
- Lack of promotion of new implements already developed.

UNIVERSITY OF AGRICULTURAL SCIENCES, RAICHUR

Status of varieties of seeds / planting material released in the last three years

- TS-3R Pigeon pea: This variety has high yield potential of 14-18 q/ha. It is resistant to wilt and sterility mosaic is a replacement to Gulyal local genotype. Easy to identify off types during seed production. The duration of the variety is 145-155 days and is recommended for cultivation in zone 2 of the state.
- RSFV – 901, Sunflower: This variety has high seed yield of 15-20 q/ha and oil yield of 50% over check Modern. The variety has high oleic acid content of 66 – 79%. It is found to be resistant for rust and tolerant to SND and Downy mildew and Powdery mildew diseases. The variety matures in 95 – 100 days period and is recommended for zone 1 & 2.
- PTR – 6, Tomato: This variety is recommended for zones 1 & 2 for processing purpose. Fruits are medium in size, has yield potential of 40-45 t/ha. The variety has a blend of sugar acid and matures in 120 days period and is tolerant to early blight and leafcurl disease.
- Paddy, GGV-05-01 (IET-20594): This variety is high yielding and cultivated both in Kharif and summer seasons. Medium slender grain and matures in 130 - 135 days. Recommended for zones 2 & 3.
- Finger Millet DHRS-1: This variety is high yielding and recommended for zone 3.
- Chickpea MNK-1: This variety is high yielding

Performance of equipment and machinery introduced:

The following equipment / machineries have been introduced in the region.

1. Paddy transplanter (Walk behind type and riding type)
2. MPKV planter for Jowar (Tractor Drawn)
3. Groundnut Thresher
4. Sunflower Thresher
5. High capacity Thresher for sunflower, safflower etc.
6. Low land and Rice Seeder
7. Cono weeder
8. Inclined plate planter (Animal drawn)
9. Self-Propelled high clearance sprayer
10. Rotovator

11. Self-propelled vertical conveyer reaper
12. Long boom sprayer
13. Roto-till drill
14. Vertical conveyer reaper (Tractor mounted)
15. Flow through paddy thresher
16. Groundnut pod stripper
17. Wheel hoe

The performance of all the above equipment in the field was good and by the use of these equipment, the cost of cultivation was reduced (between 6% - 59%) and also time was saved (between 20% - 68%) in doing agricultural operations.

Efficacy of new programme in Extension Education:

The new programmes related to extension being implemented by the University of Agricultural Sciences, Raichur have made a good impact. The new programmes viz. Integrated Farming System, INSIMP Programme, Bhuchetana Programme etc. have helped the farmers in getting higher yields.

UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT

Status of varieties of seeds / planting material released in the last three years

The University of Horticultural Sciences, Bagalkot has released three varieties namely Bhagya (KDM-01) in drumstick, Apoorva in Capsicum and Kalpataru in coconut. The status of the above varieties is as follows:

Crops	Variety	Seeds/ Planting material sold	Seeds/ Planting material available	Remarks
Coconut	Kalpataru	16080 seed nuts 7636 seedlings	40,000 seed nuts 20,000 seedling	Popular & accepted by farmers
Capsicum	Apoorva	1.0 kg seed	2.0 kg seeds	Needs popularization
Drumstick	Bhagya (KDM-01)	5155 seedlings 124.2 kg seeds	10,000 seedling 200 kg seeds	Popular accepted and adopted by farmers

Responses to the package of practices to soil/ plant nutrient management, plant protection, irrigation, agronomy, agricultural practices.

- The Package of Practices for horticultural crops developed by University of Agricultural Sciences, Dharwad and University of Horticultural Sciences, Bagalkot needs to be revised.
- University of Horticultural Sciences, Bagalkot is revising and developing package of practices for vegetables, fruits, flowers, plantation crops medicinal and aromatic crops taking into account of what has been done by different R & D institutions.

Assessment of technology and package of practices for reclamation of lands (saline / waterlogged etc.).

A survey is being conducted on the saline soils in the command areas and sugarcane growing areas for taking up suitable alternate technologies for reclamation of such soils/lands.

Success or failures of new crop rotation/ cropping sequences / mixed cropping etc.

- Pomegranate - sapota cropping sequence was the most popular in the district of Bagalkot since time immemorial. However, because of bacterial blight of pomegranate this sequence is a failure now.
- Sugarcane used to be rotated with cotton. The farmers are not going for cotton. Instead they go for maize or sunflower.
- Arecanut is affected by yellow leaf disease (YLD) in Sringeri, Koppal and NR Pura of Shimoga district. Besides working for remedial measures, alternate crops are being suggested.

Performance of equipment and machinery introduced

Coconut tree climbing equipment, snow ball tender nut machine, tender nut cutter and punching machine developed by CPCRI are introduced in the traditional coconut growing areas of Karnataka. The farmers need to be educated for populating these equipments.

Efficacy of new programmes in Extension Education

The new programmes in Extension Education are attracting the rural youth for ex. e-extension is having good impact. The flagship programmes like IFS demonstrations, Bhu-chetarn are found to be creating positive impact.

PUDUCHERRY

DEPARTMENT OF AGRICULTURE, PUDUCHERRY

Major activities

1. During 2010-2011 through Perunthalaivar Kamaraj Krishi Vigyan Kendra (PKKV), Agriculture Department, Puducherry has undertaken popularization of paddy varieties CO (R) 50 & CORH3 and Brinjal COBH2 under Front Line Demonstration programme. Though the yield of Brinjal COBH2 was higher, the variety was not preferred in the local market when compared to PLR-2.
2. Integrated Crop Management and Integrated Pest Management programmes were demonstrated to the farmers in groundnut and black gram varieties VR12 and Vamban 3 respectively. The farmers were quite satisfied with the performance of the technologies advocated under this programme.
3. It is planned to take up soil reclamation programmes under RASHTRIYA KRISHI VIKAS YOJANA (RKVY) during the next year.
4. No programmes were taken up on new crop rotations/cropping sequence/ mixed cropping etc.
5. The following processes / products were taken up to farmers level under demonstrations:
 - (a) Application of mycoinsecticide using *Beauveria bassiana* for control of leaf folders.
 - (b) Application of Arka banana special micronutrient mixture.
 - (c) Application of fish oil resin soap to contain mealy bug in papaya.

The above processes and *Beauveria bassiana* is well accepted among the farmers. The technology of fish oil resin soap to contain mealy bug is quite effective in initial stages of incidence. But the incidence of mealy bug in papaya was low during the period of the demonstration. Foliar application of Arka banana special micronutrient mixture is well accepted and widely adopted by the farmers.

6. During 2010-2011 farmers were demonstrated with paddy nursery raising for mechanization and paddy transplanter. There was very good response among the farmers towards mechanization of paddy cultivation as there was considerable labour and time saving.
7. Under fodder cultivation, introduction and popularization of forage grass CO4 was demonstrated among farmers during the year 2010-2011. Growth of CO 4 fodder grass is found to be better than earlier varieties.
8. Efficacy of New Programme in Extension Education: ATMA scheme under extension reforms is being implemented effectively by the Department of Agriculture, Puducherry. The scientists from PKKVK are delivering expert lectures during the meeting of BTT, etc. Also PKKVK functions as SAMETI by organizing training to extension functionaries.

Extension: PKKVK is provided with e-connectivity with a separate link to satellite at a selective bandwidth. Through this connectivity the PKKVK is linked to 200 research stations including ICAR Headquarters enabling the scientists and farmers of the region for data mining to acquire latest technologies from the various institutions all over the country. The scientists and farmers are also being benefitted through the e-seminars regularly telecast from ICAR Headquarters.

Bulk SMSs covering pest and disease incidence, training information, latest technologies in agriculture are also being sent to the mobiles of the farmers of Puducherry Region using this e-connectivity facility.

Package of practices to soil / plant nutrient management, plant protection, irrigation, agronomy, agricultural practices etc.

The State Ground Water Unit & Soil Conservation unit attached to this Department is implementing the following two subsidy schemes with a view to conserve water in the field of irrigation.

- 1) Subsidy to farmers for laying of underground pipe line for conservation of water for irrigation at 75% subsidy to general farmers and at 100% subsidy to SC farmers subject to a maximum of ` 30,000/individual
- 2) Subsidy to farmers for Installation of micro-irrigation system for conservation of water for irrigation at 90% of the total cost or 25,000/ha whichever is less for small and marginal farmers, SC/ST and women farmers and at 70% of the total coat or 25,000/ha, whichever is less for other farmers / institutions.

ANIMAL HUSBANDRY DEPARTMENT, PUDUCHERRY

Popularity of new strains / species in cattle / poultry /fisheries:

In this regard, it is stated that there is no specific breed of cattle / poultry identified for the Union Territory of Puducherry. Whatever the species and breeds of cattle and poultry available in the neighboring districts of Tamil Nadu / Kerala / Andhra Pradesh are seen in the relevant regions of the Union Territory.

- Pondicherry Region - The situation is similar to that of Cuddalore and Villupuram districts of Tamil Nadu.
- Karaikal Region - The situation is similar to that of Thanjavur and Nagapattinam districts of Tamil Nadu.
- Mahe Region - The situation is similar to that of Calicut and Kannur districts of Kerala.
- Yanam Region: The situation is similar to that of Kakinada of Andhra Pradesh.

Cattle Development

Pondicherry and Karaikal region: The major livestock production seen in Pondicherry and Karaikal are from indigenous stock, now available as cross bred stock upgraded with Jersey breed. 90% of the present stock is cross bred Jersey stock. At present efforts are being made to sustain the blood level of 50% to 66% exotic breed. Breeding is done with 50% cross bred semen. Semen is being procured from 'A' grade certified semen centres of the country since semen production is not done in the U.T. Buffalo production is not taken up by the farmers in this region and the population is very low. For the existing population, breeding is done with Murrah semen.

Mahe region: Being the smallest region of this U.T., the cattle population is very low. The situation prevailing at Kerala is comparable to the conditions. Only cross bred cows are being maintained in this region. There is no buffalo population. Kerala Livestock Development Board is supplying the semen for this region. Cross bred Jersey semen is being used for breeding.

Yanam region: Buffalo is the preferred cattle of this region and contributes major part of milk production. Murrah semen is being used for breeding of buffalo. There is no specific identified breed / strain of cattle available for this Union Territory. The existing stock are graded stock. Therefore, the Government has not taken up any conservation work for preservation of indigenous germplasm.

Poultry Development: The poultry industry in the UT is in a status of backyard production and yet to attain the industrial status. Only few farmers are indulging in commercial poultry farming especially in poultry meat production. Due to unstable price of poultry, they gave up own farming and prefer contract farming for a stable earning. The Government has set up poultry farms in all four regions to demonstrate poultry farming and to supply improved stock to the local farmers. Inputs and service are provided to poultry farmers free of cost. Annually the Government supplies certain strains of poultry like Giriraja and commercial layer strains for backyard production and for improvement of local stock. There is no specific identified breed / strain of poultry available for this Union Territory. The existing stock are desi poultry, cross bred stock of Giriraja and commercial strains. Therefore, the Government has not taken up any conservation work for preservation of indigenous germplasm.

Feed & fodder availability:

Rapid industrialization and use of cultivable land for nonagricultural industries has resulted in reduction in availability of agricultural products and byproducts leading to increase in the cost of feed and fodder, consequently affecting the returns from livestock products.

Suggestions for improvement:

- As the cultivable land is shrinking, sparing land exclusively for fodder production has only little scope. Therefore, the researchers should also find out alternative resources like new fodder plants which are high yielding and fodder trees which could provide required food materials to livestock by limited usages of land.
- As the cost of production of feed and fodder are increasing, suitable economical feed formulations are to be evolved to alleviate the burden of livestock owners on the cost of feeding of animals.
- The geographical position of this U.T. is scattered and the four regions have different topography, culture and variable needs. Therefore the policies taken for bovine productivity especially with the aim to meet the demand should be in accordance with the need. Therefore, in respect of this U.T. there need not be a separate policy, but the policies of the neighboring states must be followed at the respective regions so that the productivity could be achieved and needs shall be fulfilled.

AGENDA ITEMS FOR DISCUSSION

DEPARTMENT OF HORTICULTURE AND PLANTATION CROPS, TAMIL NADU

Crop Improvement:

- More hybrid varieties so as to compete with private producers are to be developed in almost all gourds.
- A tapioca variety more suitable for rainfed area is needed.
- Suitable tissue culture varieties in Red Banana, Kathali and Nendran may be suggested.
- A leaf spot resistant banana variety may be evolved.
- Tissue culture technology may be evolved and standardized for the multiplication of major fruit crops like mango, guava etc.
- A hybrid chillies of gundu type needs to be developed especially for Sivagangai and Ramanathapuram districts since it is the long felt need of the farmers.
- Suitable tomato varieties for green houses are to be identified
- A table variety with mosaic resistance is needed in papaya
- Brinjal varieties with resistance to fruit / stem borers are needed.
- In bhendi, YVM resistant variety is needed
- In tapioca, CMV resistant variety is needed

Crop Production:

- Water soluble fertilizer recommendation for fruit trees like mango, guava.
- Suitable package of practices for rainfed areas particularly for tapioca is required
- Agronomical practices which are less labour consuming and help in holistic management need to be evolved for horticultural crops.
- Package of practices for cut rose cultivation under open condition.
- Package of practices for tropical cut flowers like Orchid, Anthurium, Heliconia and China Aster for Kanyakumari district.
- Package of practices for cultivation of Hybrid Marigold (Yellow Variety) in Kanyakumari district under open condition.
- A special package for Noyyal effluent affected area is to be developed.
- Of late, erratic bearing tendency is noticed in Aonla crop. When pruned after the harvest, the vegetative phase dominates over the reproductive phase. Heavy bearing during one season and little or no crop in the next season as in the case of mango is happening. Suitable technology may be evolved to overcome the irregular bearing in Aonla.
- Package of Practices is needed for Green House cultivation of crops especially for tomato and Capsicum.
- Technologies to overcome problems due to climatic changes
- Schedule of organic substitutes to replace or reduce chemical fertilizers and botanic formulations in for crop production.
- Standardization of mulching technologies for various crops.
- Water soluble fertilizer recommendation for fruit trees like mango, guava.
- Economics of water soluble fertilizers in accordance with Soil
- Testing Laboratory recommendation.
- Package of practices exclusively for T.C. Banana cultivated in wetlands.

- Integrated managerial practices for problem soils like saline and alkaline soils may be developed

Crop Protection:

- Neem based bio pesticide usage is to be incorporated for all vegetable cultivation packages
- The bio-control agents like parasites and predators and bio pesticides like NPV and pheromone traps are not readily available for use even if some progressive farmers come forward to adopt them. Hence commercial availability of these bio inputs must be ensured.
- In Dindigul District, medicinal plant Gloriosa is being cultivated in an area of 600 ha. During rainy season, water soaked leaf spots appear in the leaves. Under extreme conditions, these spots also are seen in vines. Then the spots coalesce in to dark circles leading to premature leaf fall and sudden death of entire plant. The symptoms look like Curvularia leaf spot and leaf blight. This disease does not respond to any broad-spectrum fungicide now available in market. Suitable remedial measures both preventive and curative nature may kindly be evolved and standardized to contain this disease.
- Effective control measure for the deadly weed parthenium needs to be evolved.

Machineries and Equipments:

- To tackle the problem of clogging of drippers with the salts present in irrigation water and fertilizers hi-tech unclogging drippers may be developed
- Rodent proof laterals for micro irrigation.
- Locally designed bund former (For forming ridges & furrows) is being used in Oddanchatram tract for vegetable cultivation. This is not a tailor-made implement and lacks precision. Hence tractor drawn bund former with width adjusting mechanism (1-1.5M) may be evolved so as to enable the small and marginal farmers to make use of the implement as they are reeling heavily under labourer shortage.
- Small scale equipments for harvesting of all vegetables and flowers may be developed for all possible crops.

Post Harvest Technology:

- Safe and quick process of mango ripening is needed to avoid wastage of mangoes.
- Easily adoptable technologies to increase the shelf life of various produces - Zero energy cool chamber, cold storage etc.
- Standardization of optimum temperature, RH, method of packaging/ storage, period of storage etc. has to be done
- Eco-friendly method to prolong the ripening process of tomato at field level

Others:

- The technical officers of the department may be exposed to the Products / processes released by TNAU at TNAU KVKs or Research Stations at least once in a month
- Turmeric harvester performs well in field condition but slight modification is necessary for better utilization because it is felt by the farmers that more rhizomes get damaged at the time of harvesting.
- Samples of newly released seeds and planting materials may be supplied to State Horticulture Farms for further multiplication and distribution to farmers.
- Demonstration of equipments and machineries may be conducted at important places (Progressive farmer's fields)

- The deadly weed, Parthenium is being used for making vermicompost in a field near Chennimalai. The process and technology is appreciable. The weed, Parthenium is well composted and the same is utilized for their Amla crop. This technology may be fine-tuned through research to address the weed menace effectively.

UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

1. **Pest and disease surveillance:** The disease forecasting units and the pest surveillance work need expanding area of operation up to taluka level. Similarly, mobile plant health clinics are essential to provide advisory services to farmers. Private – Public – Peoples Participation mode is the key to such ventures.
2. **Farm power, machinery and energy management:** This is an emerging area of utmost importance in view of urban migration, reduction in work force on farms, feminization of agriculture and shortage of power, which is slowly restricting development.
3. **Organic agriculture:** The concept needs enhanced efforts in light of global food supply chains that are to be maintained at a much larger level. It is imperative that organic foods should account for a sizeable portion of agriculture trade in the coming days. Certification of organically grown produces, separate market channel for organic produce with good price, etc. are essential.
4. **Market intelligence:** There is a felt need to provide backward and forward linkages to the agriculture production system exploring viable options which are location specific. E – chaupals, E-marketing etc., are the available options.
5. **Gender issues in agriculture:** Agriculture is increasingly becoming the domain of rural women whose contributions go unpaid and unrecognized as well. Efforts to reduce drudgery to rural women and to organize them towards obtaining land rights, credit facilities and awareness including capacity building are the issues to be addressed at once.
6. **Importance of sericulture research in Region-VIII:** Sericulture is one of the important activities undertaken in the states of Karnataka, Tamil Nadu and Andhra Pradesh. There is a need to formulate common research programmes and extension strategies to address issues pertaining to sericulture and popularize the activity in the region.
7. **Crop mapping in Region VIII:** There has been a considerable shift in the cropping pattern in the region in recent years. In order to draw realistic crop plans, there is a need to document the extent and spread of crops in the region. This may be taken up at the earliest.
8. **Updating of status report for agro-climatic zones in each state of Region- VIII:** The status report for agro-climatic zones in each state located in region was prepared during 1980s under National Agricultural Research Project (NARP). There is a need to update the status report in the changed scenario of shift in the rainfall pattern, depletion of water resources and shift in cropping pattern to draw research programs.

UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

1. **Providing one time grants to the colleges which have completed 50 years:** The colleges which have completed 50 years may be provided with a lump sum grant of Rs.10 crores for the development of infrastructure and required facilities to cater to the present day requirements and modernization of laboratory, field and class room facilities. One time grants of Rs.10 crores may be provided to the College of Agriculture, Dharwad, which has completed 65 years (year of establishment 1947).
2. **Increase of SAUs grants for Experiential Learning programme:** UAS, Dharwad has implemented Experiential Learning Programme for the Final Year students from 2010. We have already formulated nine Experiential Learning Programmes in Animal Sciences, Biological Sciences, Commercial Agriculture and Natural Resource Management. In order to

make the Experiential Learning Programme effective, it is necessary to develop new infrastructure facilities for which huge amount is required. The present allocation of budget under SAUs for education is meager to cater to the needs of these programmes. Hence, substantial amount has to be earmarked for undertaking the Experiential Learning Programmes.

3. **RAWE programmes for Final year UG students:** As per the recommendations of the IV Deans' Committee report, the SAUs have implemented RAWE programmes in their curriculum for final year UG students. The stipend for the RAWE programmes is Rs. 1000- per month, of which, 75% is the share of ICAR. It has been observed that the students are finding it difficult to maintain themselves when they go out for village stay programme. In view of the sharp increase in the prices of all the essential commodities, it is submitted that ICAR may consider enhancing the stipend to Rs. 2,000/ month per student so that the student can concentrate on the programme outside the colleges and learn practically in the field.
4. **Study tour for III and Final year Under-graduate students:** As per the IV Deans' Committee recommendations, there is no State Study Tour for under-graduate students. Earlier students had State Study Tour and All India study tour during III and final year under-graduate programme, respectively. If the students are exposed to various educational institutions concerning agriculture research, education and extension, it will really broaden their mind and hence it is requested to include both State Study Tour as well as All India Study Tour for under-graduate students. There is also a request from the students and the students are very unhappy over the withdrawal of their study tour.
5. **Implementation of new Post-graduate syllabus from the academic year 2009-10:** Keeping in view the recommendation of Indian Council of Agricultural Research, UAS, Dharwad has implemented new Post-Graduate Syllabus with effect from 2009-10 academic year. It has already been discussed in the Vice-Chancellor's Conference meeting that in order to offer courses as per the new syllabus; teachers need to be trained in various aspects. There are lot of new things which are incorporated in the syllabus, keeping in view the latest developments in science. It is necessary that we have to impart quality education to the students; hence, a special provision be made in the allocation of SAUs grants exclusively for training faculty both within the country and abroad on various objects.
6. **Strengthening of research programmes at SAUs based on the changed agriculture scenario:** The cropping pattern are changing very fast now due to various reasons including the climate change impact. Several crop species are being grown in nontraditional areas and shifting of seasons is becoming common. However, due to non-availability of technologies for such situations, the productivity of the crop species in the new and non-traditional areas will be very low. It is therefore suggested to provide more support for strengthening and establishment of following research programmes under AICRP at UAS, Dharwad.

UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT

- For development of infrastructure in the newly established research station / the stations to be established by the universities, a onetime infrastructural grant of Rs.500 lakhs may be given by ICAR to have state of art facilities for carrying out research and extension activities.
- Provision of special funds for the development of extension system in the newly established University of Horticultural Sciences, Bagalkot has to be made. The following proposals have been submitted to the ICAR
 - Establishment of ATIC;
 - Construction of Farmers' Hostel
 - Construction of staff training Unit
 - Mobile soil / water / plant testing Unit

DIRECTORATE OF ANIMAL HUSBANDRY KERALA

- Studies on the possibility of producing vaccine against mastitis disease
- Study on nutritional infertility in cattle
- Study on the Kasaragod Dwarf cattle and Badagara Dwarf cattle
- Study on Chara and Chempally variety of ducks
- Study on Thalassery variety of poultry

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

Efficacy of new programme in extension education should be discussed

- Food security army for labour scarcity – trained equipped youth
- Green cadet corps in schools
- Public – private partnership model for women entrepreneurship development

RAJIV GANDHI COLLEGE OF VETERINARY AND ANIMAL SCIENCES, PUDUCHERRY

- Accreditation / affiliation of RAGACOVAS under ICAR and including our institute as partner of veterinary education and research
- Financial assistance to the staff members for up-dating the knowledge.
- Request for resuming of ICAR Ad-hoc scheme.
- Funds for Infrastructure Development Grant for the colleges.
- Introduction of old system in ASRB competitive examination to recruit the scientists in specialized areas.
- Rating of ICAR allied colleges for better quality higher education.
- Granting one time grant for developing Institutional Livestock Farm Complex in each veterinary college to offer training for the farmers and students since many colleges could not develop this facility due to paucity of the fund.
- Research on livestock extension models in India.
- Establishing livestock information centres in the regions where livestock rearing holds the key of sustainable development.
- Establishing an academic staff training college to train agriculture, veterinary and fisheries faculty in various institutions in the region on aspects such as teaching methodologies, personality development, communication skills, leadership development, stress management, student teacher relationships etc.

INDIAN GRASSLAND AND FODDER RESEARCH INSTITUTE ,RESEARCH CENTRE, DHARWAD

- Collaboration between IGFR, SRRS, Dharwad and AICRP on Biological Control (NBAIL, Bangalore) may be planned for enhancing the scope and feasibility of biological control in forage crops. Further, collaboration is required with NBAIL, Bangalore in the field of taxonomy and biodiversity of insect fauna of forage crops.

CENTRAL TUBER CROPS RESEARCH INSTITUTE, THIRUVANANTHAPURAM

- Popularization of biopesticides produced by CTCRI from cassava by the SAUs against the sucking pests of vegetable crops and borer pests of tree crops.
- Cultivation and utilization of tuber crops have to be intensified in the nontraditional areas like Lakshadweep and Union territory of Puducherry.

- KVKs and State Agricultural Farms should get actively involved in the production of planting materials of improved varieties of tuber crops.
- Lack of awareness about the potential of tuber crops for value addition is posing a bottle neck in the commercialization of the various value added products developed by CTCRI. The KVKs and the Agricultural Departments in the States other than Kerala as well as Puducherry should be proactive in sending Agricultural Officers / Assistants to participate in the training programmes at CTCRI.

AICRP ON TUBER CROPS

- Requests from the Kerala Agricultural University and University of Agricultural Sciences, Shimoga, Karnataka for inclusion as New Centres under AICRP on Tuber Crops.

NBSS & LUP, REGIONAL CENTRE, BANGALORE

Land Resource issues affecting agricultural productivity and soil health

- Increasing wasteland areas in all states
- Salinity/sodicity, a serious problem in all irrigated lands (canal/tanks)
- Widespread multiple nutrient deficiencies in soils and crops
- Over exploitation of ground water
- Significant increase in current fallows
- Invasion of *Prosopis* in all the fallow and cultivated fields
- The NARP Zone concept adopted by SAU's needs reconsideration
- Need for refinement of fertilizer recommendations- site and soil specific
- Lack of linkages between the agro-technologies developed and developmental schemes implemented due to poor characterization land resource database

The issues listed above are common to all the states. They need to be addressed at the earliest, to maintain / increase the agricultural productivity. Lack of site specific database is the main cause for the failure of most of the schemes, both central and state sponsored. This can be overcome by taking up

- Detailed mapping of soil and other land resources at village level (1:10000 scale) using cadastral maps as base in conjunction with remote-sensing data
- Identification of degraded & waste lands, their extent at village level
- Identification of resource constraints affecting crop production
- Evaluating the fertility status of all farm holdings and preparation of village level fertility maps
- Evaluating the resources for existing and alternate land uses
- Recommending location-specific cropping patterns and farming systems
- Establishing digital data bank for natural resources & Village Resource Centre at Block level and Village Knowledge Centre in each village
- Enable the line departments to prepare their action plan
- Provide baseline information for implementation, monitoring and post-facto evaluation of schemes
- Identify Benchmark sites and hot spots for periodic monitoring of the State of Land and Water Resources

For this, a collaborative project on Land Resource Inventory and Geographical Information System for Perspective Land Use Planning at Macro level and Farm Planning in all the states on a

mission mode by involving NBSS & LUP and other central and state institutes listed below is suggested.

- State Agricultural Universities
- Department of Agriculture / Horticulture and STL and FTL officers
- Agricultural Engineering Department / Watershed
- Department of Forestry, Environment etc.
- NGO'S and other grassroots level workers
- All ICAR / Other Central institutions

DIRECTORATE OF WATER MANAGEMENT, BHUBANESWAR

- Standardization of indigenous auto irrigation systems and designing low cost organic fertigation system for homestead vegetable production
- Monitoring GW pollution due to agrochemicals and industries in LBP command
- Technology development on sub-surface drip-fertigation for higher crop productivity in sugarcane
- Evaluation of herbicides applied through drip irrigation in important field crops
- Evaluation and optimization of the specialty water soluble fertilizers and sulphur for higher productivity in sugarcane under drip-fertigation system
- Sub surface drip fertigation for maize based cropping system
- Drip-fertigation for improved variety and hybrid rice under aerobic condition
- Research on groundwater recharge with emphasis on assessing effectiveness/impact of groundwater recharge structures and preparation of guidelines for groundwater recharge in hard rock areas of Tamil Nadu.
- Efficient conjunctive use planning of scarce surface and groundwater resources at command level.

AICRP ON DRY LAND AGRICULTURE

- Strengthening of linkages between AICRPDA and KVKs in the domain districts under NICRA for up-scaling of rainfed technologies during 12th Plan.

ZONAL PROJECT DIRECTORATE, BENGALURU

Administrative:

- As the tasks being performed by KVK staff is comparatively difficult and most of their output is intangible, there should be a separate scorecard for promotion of KVK Staff.
- Staff transfers should be kept at a minimum and if inevitable, have to be well planned and obtain prior approval of ICAR so that alternate arrangements will not affect continuity, institutional memory and progress.
- There should be policy decision on KVK staff should serve for a minimum period of 5 years.
- Filling up of vacant posts in KVKs shall be taken on priority basis by SAUs.
- Adequate training has to be provided to Subject Matter Specialists of KVK in marketing, post harvest technology including value addition, planning, and monitoring & impact assessment studies.
- KVK Staff should not be diverted for any other station or work other than that of mandated works.

Technical:

- Directorates of Extension need to provide adequate technological backstopping to all the KVKs irrespective of the host organization.
- Director of Extension need to attend Scientific Advisory Committee Meetings of all KVKs irrespective of host organization and provide technical support and guidance.
- Technology Inventory shall be updated and published at regular intervals by the Directorates of Extension.
- After the Institute Research Council meeting, ICAR institutes may provide latest technologies to the KVKs for assessment/refinement or demonstration
- KVK-ATMA linkage need to effective and in this regard the process of providing resources by ATMA to the KVKs may be reviewed and simplified
- Cross learning across KVKs needs immediate attention for improved performance of every KVK.
- KVKs must adhere to the mandated activities as decided by the host institution and ZPD. Additional jobs to KVKs should be informed to ZPD well in advance and have to be taken up keeping in view the planned and mandated activities, strength and skills of existing staff, additional resources (manpower and financial) that would be made available to perform the additional jobs etc.
- If the present trend of over-loading with additional jobs of KVKs continues, it is feared that KVKs will wither away under their own weight.
- Identification of champion farmers, train them on different aspects and use them as trainers, with suitable compensation, could be tried to cover the large number of uncovered farmers.

Financial

- SAUs must open separate account for KVK and ensure the funds are utilized for the purpose for which they have been sanctioned. Similarly, the revenue generated by KVK to deposit in the revolving fund account and must be ploughed back to the KVKs for infrastructure and other developments.
- Release of funds in four installments/quarterly basis may be made for all the KVKs by ICAR for effective implementation of mandated programmes

IRRIGATION MANAGEMENT AND TRAINING INSTITUTE, TRICHY

1. Districtwise cost of cultivation and profit for sugarcane may be finalized
2. Suitable districts for profitable sugarcane cultivation may be declared
3. Package of practices for reducing water requirement
4. Short duration sugarcane varieties for different districts may be identified and recommended
5. Drought resistant varieties suitable for drought prone districts may be finalized
6. Package of practices for quality jaggery making may be finalized
7. Organic farming package may be finalized
8. Popularization of pit method of planting of sugarcane

Directorate of Sugarcane Development, MoA, GoI

- Development of sugarcane variety suitable for biotic and abiotic stress conditions having good sugar recovery, field stability and ratoonability.

INDIAN VETERINARY RESEARCH INSTITUTE, HEBBAL, BANGALORE

- The FMD control programme is at present implemented in all the states and UTs which is included in this Regional Committee No. VIII. There is a need for all the state departments of Animal Husbandry, universities and KVKs to work together in educating the farmers in this region as it is having immense benefit to the livestock sector. There is a need to increase the extension activities and strengthen the disease reporting mechanism. The uniform and timely implementation of the control programme is very essential for the success of the programme.

CENTRAL SHEEP & WOOL RESEARCH INSTITUTE SOUTHERN REGIONAL RESEARCH CENTRE, MANNAVANUR

- The demand for both Bharat Merino & broiler rabbits has increased tremendously, additional sheds for animals and infrastructure to be provided to cater to the needs. The SRRC of CSWRI has to be strengthened further for the benefit of farmers of Southern States.

CHAPTER IV

STATUS OF RESEARCH IN CROP SCIENCES

FOOD AND FODDER CROPS

RICE

The area under rice during 2007 - 08 (Annexure I) in the states of Tamil Nadu, Karnataka, Kerala and the UT Puducherry was about 3.8 million ha which is about 8.6% of the total rice area of the country and contributed about 10.6 % (10.1 million t) of the total rice production of the country. With reference to 2005-06 base data, the area under rice during 2009 - 10 decreased in all the states except Karnataka. The production also decreased during 2009 -10 due to drought. The average rice yield in this region is 2.2 t/ha which is on par with the national average. During the above period Tamil Nadu has made an impressive gain of 4% per year in productivity and 8% in production.

Almost all the rice area is irrigated in Tamil Nadu (93.2%); it is about 75% in Karnataka and 72% in Kerala. The entire area under rice in Tamil Nadu (94.9%) and Karnataka (92.9%) is covered with high yielding varieties (HYV). It is about 60% in Kerala. The gain in production (70%) in Karnataka, despite a decrease in rice area (9%), could be attributed to improved productivity through high yielding varieties and hybrids.

Tamil Nadu and Puducherry

Recently released rice varieties for different ecologies:

Irrigated: Annalakshmi, Subramanya Bharathi, ADT (R) 45, ADT (R) 46, CO 47, CO(R)48, CO(R)49, Paramakudi (R) 4, RMD(R)1, TRY (R) 2, TRY 1.

Rainfed shallow lowland: KKL(R)-1, ADT 44

Saline: AU 2, PVR 1, TRY (R) 2, TRY 1

Rainfed upland: Paramakudi 1, PMK (R) 3, TKM (R) 12, Vaigai

Popular HYVs: ADT 36, IR 50, ADT 37, ADT 39, ADT 43, ADT 45, White Ponni, CoRH 3, IR 36, IR 64, CR 1009

Traditional rice varieties: Kuliadichan and Norungan (highly drought tolerant), Anaikomban, Chennellu, Peniakichili, Kuruva, Senkuruva, Vellaisamba, Chitrakali, Red Sirumani, Konakuruva

Major production constraints:

Biotic: *Pests:* Leaf folder, Stem borer, Gall midge
Diseases: Blast, Bacterial Leaf Blight, Rice Tungro Virus

Abiotic: Salinity; Zinc deficiency

Karnataka

Recently released rice varieties:

Irrigated: BR 2655-9-3-1, CSR 22, Kadamba, KHP 10, MGD 101, Mugad Siri 1253, Thanu, Tunga, Mugad SugandhBR 2655-9-3-1

Rainfed upland: Tulasi (CVRC released), Amrut, IR 30864,

Rainfed shallow lowland: Asha, PUBM-8, Madhuri

Deep water: Hemavathi

Aerobic: MAS 26, MAS 946-1, Ona Siri, Sharada

Traditional rice varieties: Alur gidda, Alur Sanna, Bangarakaddi, Biliyakki, Champakali, Chippige, Devamallige, Dinnebattha, Doddinellu, Dodigo, Doddabyranellu, Gandasali, Hosudi Bili, Hosudi Kari, Intan, Jeerige Sanna, Jenugudu, Karibatha, Karidodi, Kiribiliya, Kiruvana, Mambiliya, Nerguli, Puttabatta, Tellahamsa, Uduru Mallige.

Popular Varieties: Alur gidda, Alur Sanna, Bangarakaddi, Biliyakki, Champakali, Chippige, Devamallige, Dinnebattha, Doddinellu, Dodigo, Doddabyranellu, Gandasali, Hosudi Bili, Hosudi Kari, Intan, Jeerige Sanna, Jenugudu, Karibatha, Karidodi, Kiribiliya, Kiruvana, Mambiliya, Nerguli, Puttabatta, Tellahamsa, Uduru Mallige

Hybrid: KRRH-2

Major production constraints:

Biotic: *Pests:* Brown plant hopper, Gall midge, Stem borer
Diseases: Blast, Sheath rot

Abiotic: Zinc deficiency

Kerala

Recently released rice varieties:

Irrigated: Anashwara (PTB 58), Dhanu, Gouri, Kunjukunju Priya, Kunjukunju Varna, Pratheeksha, Samyuktha, Swetha, Vaishak, Varsha, Vytilla 8

Rainfed upland: Chingam, Harsha, Suvarnamodan

Rainfed shallow lowland: Kanchana, Karuna, Kumbham, Lakshmi, Makaram, Neeraja, Nila, Rasmi

Saline: DRR Dhan 39 (CVRC released), Sagara, Vyttila 6, Vyttila 4, Vyttila 5

Traditional and popular rice varieties: Orumundakan, Chettivirippu (VYT-1), Cheruvirippu (VYT-2) (salinity), Kallada champavu, Kochathikkira (acidity), Cherady (flash floods), Thondi, Palthondi (high altitude). These varieties occupy 9.25% in autumn, 21.67% in winter and 1.1% in summer.

Popular HYVs: Area under popular varieties is 90.75% in autumn, 78.33% in winter, 98.89% in summer. The varieties are Jyothi, Uma, Aiswarya, Kanchana, Aathira, Bhadra, Pavizham, Krishnajana, Gouri, Krishma and Manu Priya.

Major production constraints:

Biotic: *Pests:* BPH, Stem borer, Gall midge, Leaf roller, Rice bug

Diseases: Blast, Sheath blight, Sheath rot, Brown spot, False smut, Leaf scald, Grain discoloration, Bacterial leaf blight, Rice tungro virus, Grassy stunt virus

Abiotic: Salinity (30,000 ha); zinc deficiency (30%), copper (21%), calcium (30%), magnesium (16%) in Kuttanad; Cold in high ranges in Punja season; Drought in Palakkad and Onattukara; Cyclones & flash floods and saline water intrusion in Kuttanad; Others: Rodents

SORGHUM

Area, production and productivity: (Annexure II)

Karnataka: Sorghum is cultivated in Karnataka during *kharif* and *rabi* seasons, meeting the dual needs of grain as well as fodder. However, in some areas it is exclusively grown for green forage production.

Tamil Nadu: Sorghum is being cultivated in *kharif* and *rabi* as a dual purpose crop. In some areas it is grown exclusively for green fodder. There is not much of a variation over time in terms of area, production and yield in Tamil Nadu.

Kerala, Puducherry and Lakshadweep: Sorghum cultivation is very little in these states. However, in Kerala and Puducherry, sorghum is being cultivated either as a dual purpose *kharif* crop or exclusively for green fodder by growing single-cut and multi-cut forage sorghum varieties and hybrids. In the Union Territory of Lakshadweep, sorghum cultivation is not reported.

Recommended varieties:

Table 1. Recommended sorghum varieties / hybrids

Season	Early Maturity	Medium Maturity
Grain Sorghum		
Kharif Season		
Hybrids	CSH 14, CSH 17	CSH 9, CSH 13 (dual purpose) CSH 16, CSH 18 and CSH 23, CSH 25 for Karnataka: DSH 3 & DSH 5 (Dual purpose)
Varieties		CSV 13, CSV 15, CSV 23, DSV 2, DSV 3, DSV 6 for Karnataka,
		BSR 1, APK 1, CO 24, CO 25, CO 26, CO 27, CO (S) 28 for Tamil Nadu
Rabi Season		
Hybrids	DSH 4R	CSH 15R, CSH 19R, DSH 4R for Karnataka and COH, K-Tall for Tamil Nadu
Varieties		CSV 216, CSV 22, DSV 4, DSV 5 for Karnataka and CO 24, CO 25, CO 26 for Tamil Nadu.

Major issues:

Karnataka:

The system of re-release holds back the spread of centrally released varieties and hybrids in Karnataka. This has caused serious setback in spread of centrally released varieties in this state. Karnataka State Seed Corporation also does not get proper feedback due to this reason. The Regional Committee should consider the following two items for taking decisions:

- Centrally released variety / hybrid for all sorghum growing areas including Karnataka state should be adapted without any re-release.
- State Seed Corporation should have direct access to concerned crop Director for breeder seed supply of centrally released HYV.

Tamil Nadu:

- There is no separate State Seed Corporation. As a result, specialized hybrid seed production activity is lacking and the whole programme is based on old varieties. There is no feedback of centrally released varieties to Department of Agriculture and hence the State is deprived of advantage of widely adapted varieties.
- State Seed Corporation and Department of Agriculture must have access to concerned Director at DSR, Rajendranagar, Hyderabad for breeder seed supply of centrally released varieties and hybrids.

Constraints:

Kharif

- Low adoption of improved sorghum genotypes particularly hybrids.

- Inadequate supply of seed of improved dual purpose varieties and early maturing hybrids.
- Moisture stress particularly during certain years of low and abnormal distribution of rainfall characterized by long breaks.

Rabi (Karnataka)

- Limited efforts towards seed multiplication and popularization of improved cultivars.
- Moisture stress due to growing of crop under receding moisture condition.

Significant achievements for the period 2010 and 2011:

The Varietal Identification Committee in its meeting during the 41st Annual Sorghum Group Meeting identified following varieties / hybrids for national release:

- SPH 1644- Kharif sorghum hybrid - (for Andhra Pradesh, Tamil Nadu, Uttar Pradesh, North Gujarat & Rajasthan)
- SPH 1629- (MLSH 296 Gold / DJ 2002) - Kharif sorghum hybrid - for All India -
- SPV 1870- Dual -purpose kharif variety- for All India
- SPV 1822- Dual -purpose kharif variety- for All India
- SPV 1829 - Rabi sorghum variety - for All India

WHEAT

Wheat is grown only in the state of Karnataka, in this region while it is negligible in the rest of the states. Wheat is the second most important rabi crop after sorghum and occupies an area of 2.84 lakh hectares with an annual production of 2.5 lakh tonnes.

The productivity of wheat is very low (884 kg/ha) which is due to the fact that nearly 60% of wheat is grown under rainfed conditions and crop experiences only short period the cool climate. Very often the crop is exposed to terminal heat stress causing yield loss. The other constraint being non-adoption of appropriate improved technologies viz., improved water management technologies, sowing time, seed rate, spacing etc. Karnataka is the only state where three cultivated species viz., *T. aestivum*, *T. durum*. and *T. dicoccum* are extensively cultivated. Bread wheat is cultivated in irrigated areas while durum wheat is grown in rainfed environments. *T. dicoccum* is under cultivation on large areas in northern Karnataka because of its therapeutic value and nutritional quality.

A small area under wheat is in Southern hills of Tamil Nadu state. In Tamil Nadu the change in food habit has pushed up the demand for wheat and the entire need is met by arrivals from North India. Recently the farmers in these areas are looking for an alternate viable cereal crop which requires less water as compared to rabi paddy, and assured grain yields. Trials conducted in the state have shown that the productivity of wheat in Tamil Nadu is about 25 q/ha.

Recommended varieties:

The varieties which were widely prevalent in these states and demonstrated under frontline demonstrations are given below:

Irrigated timely sown condition:	NIAW 917, UAS 415, HD 2987, MACS 6222, COW (W)-1, HW 1085
Irrigated late sown condition:	PBW 533, HD 2833, Raj 4083, HD 2932, AKAW 4627
Rainfed timely sown condition:	PBW 596, K 9644, HW 2044
<i>Dicoccum</i> wheat	DDK 1025, DDK 1029, MACS 2971,
<i>Durum</i> wheat:	AKDW 2967-16, HI 8663

Significant research achievements related to the region:

Till recently, wheat was not an important crop south of the Vindhyas mainly because winter is very short, days are warmer and favourable days for growth are too less (100 - 120 days crop only). Genotypes that are temperature tolerant and which can be grown in the peninsular zone under restricted irrigation conditions (1-2 irrigations) have been identified. Varieties for all three types of wheat (Bread wheat, *Durum* and *Dicoccum*) have been released for all the available conditions (Irrigated, rainfed / restricted irrigation, and late sowing). Short duration wheat varieties like HD 2189, DWR 162, DWR 165 etc. are also available to farmers. Future research thrust will be on breeding both durum and bread wheat varieties for the irrigated warmer areas of the peninsular parts of the country.

Production problems in the region

- Lack of irrigation facilities, non-adoption of improved varieties and improved wheat production technologies are the major problems of the region. Besides, terminal heat stress is a major constraint in increasing productivity of wheat particularly in Karnataka and plains of Tamil Nadu.
- Aphids, Black rust, Brown rust, and leaf blight are the major diseases in these states.

Issues related to transfer of technology:

In Karnataka, *dicoccum* (*khapali*) wheat is being grown at a large scale. To popularize it further, Frontline Demonstrations were conducted by Dharwad and Wellington centers in Karnataka and Tamil Nadu. Wheat FLD is one of the approaches for effectively disseminating the wheat production technology and is serving the purpose of transfer of wheat production technology to the farmers.

MAIZE

Table 2. Area, production and productivity of maize in Karnataka & Tamil Nadu during 2010-11:

State	Season	Season Area (000 ha)	Production (000 tonnes)	Productivity (kg/ha)
Karnataka	Kharif	1141	4011	3515
	Rabi	147	433	2946
	Total	1288	4444	3450
Tamil Nadu	Kharif	144	555	3858
	Rabi	87	473	5453
	Total	231	1028	4458

Recommended varieties/Hybrids

- Late Maturity(> 95 days): 900 M Gold, MCH 36, HM 11 (2009), SeedTec 2324, Bio 9681, NK 30, NK 6240, SMH- 3904, 30B07 (X-1280N), Nithya Shree (Karnataka)
- Medium Maturity (85-95 days): DHM 119, Bisco 855, KMH 25K60, HM 4, HM 8, HM 10 (2008)
- Early maturity (75-85 days): DKC7074R, PEHM 1, PEHM 2, Parkash
- Extra Early maturity (<75 days): JKMH 1701, Vivek Hybrid 15, Vivek Hybrid 17, Vivek 21, Vivek 27, PEEHM 5, Vivek Hybrid 9, Vivek Hybrid 4

Significant achievements for the period 2010 and 2011

New improved region specific high yielding single cross hybrids have been developed and released through Central Variety Release Committee (CVRC) to address several issues like low yield, lowering ground water, rising temperature etc.

SMALL MILLETS

Table 3. Area, production and productivity of finger millet and other small millets (2010 - 11)

State	Finger millet			Other millets		
	Area ('000 ha)	Production ('000 t)	Yield (kg/ha)	Area ('000 ha)	Production ('000 t)	Yield (kg/ha)
Kerala	0.2	0.3	1042	0.1	0.1	900
Karnataka	788	1556.3	1975	26	13	500
Tamil Nadu	100.9	268.4	2662	39.8	52.8	1060

Table 4. Recommended varieties of finger millet for Karnataka and Tamil Nadu.

States	Season	Variety	Remarks
Karnataka	Kar or Early <i>Kharif</i> (April-August)	Indaf 9, GPU 26, GPU 45 and VR 708	
	<i>Kharif</i> (July-November)	Indaf 8, HR 911, PR 202, MR 1, MR 6, L 5, GPU 28	Indaf 8 and MR 1 to be sown before 20 th July; GPU 45, GPU 26 and GPU 48 can be sown upto August
	Late <i>kharif</i> (Aug. – Nov.)	Indaf 9, PR 202, GPU 28, GPU 26, GPU 45 and OEB 10	
	<i>Rabi</i> (Oct. – Sept.)	Indaf 7, Indaf 15 and Indaf 9	Indaf 7 possesses cold tolerance
	Summer (January-May)	Indaf 5, Indaf 9, HR 911, GPU 26 and GPU 48	Planting <i>rabi</i> crop beyond October is to be discouraged
Tamil Nadu	Marghazipattam (Dec. - April)	CO 7, CO 11, CO 12, CO 13, CO 14, K 5, K 7, Paiyur 1, TRY 1 and OEB 10	Paiyur 1 possesses drought tolerance and hence suitable for dry districts of Salem and Dharmapuri. TRY 1 is tolerant to salinity

Table 5. Recommended varieties of other small millets for Karnataka and Tamil Nadu.

States / Crop	Kodo millet	Foxtail millet	Little millet	Barnyard millet	Proso millet
Karnataka	GPUK 3, RBK 155 and DPS 48	SiA 326, PS 4 and TNAU 186	TNAU 63, OLM 203, OLM 36 and OLM 20	VL 181, VL 172 and VL 29	GPUP 8 and GPUP 21
Tamil Nadu	GPUK 3, KMV 20 and APK 1	CO 5, K 3, CO 4, PS 4, K 2, TNAU 186 and TNAU 43	CO 2, Paiyur 1, OLM 203 TNAU 63, CO 3 and Paiyur 2	CO 1, K 2 and VL 181	K 2, CO 2, CO 3, CO 4 and GPUP 21

Major issues

- Mechanization of finger millet cultivation, harvest and post-harvest operations in small holder’s farm
- Primary processing of small millets namely little millet, foxtail millet, barnyard millet, kodo millet and proso millet
- Development of blast resistant finger millet varieties suitable for different agro climatic situations
- Development of low cost management practices including host plant resistance to control shoot fly menace in different small millets
- Development of ready-to-eat, ready-to-cook and health foods from nutritionally rich small millets

UNDER UTILIZED CROPS (Grain amaranth and rice bean)

Table 6. Area, production and yield of grain amaranth and rice bean

State	Grain Amaranth			Rice Bean		
	Area (ha)	Production (t)	Yield (q/ha)	Area (ha)	Production (t)	Yield (q/ha)
Tamil Nadu	75	90	12 - 14	25	35	13-15
Karnataka	-	-	12 -14	-	-	13-15

Table 7. Recommended varieties:

State	Grain Amaranth	Rice Bean
Tamil Nadu	Suvarna, BGA 2	RBL 6, RBL 35
Karnataka	Suvarna, BGA 2	RBL 6, RBL 35

Diseases and pests, and their management:

Amaranth: No major disease; Major pest - stem weevil
Rice bean: No major disease; Major pest - blister beetle

Major Issues and Constraints:

Amaranth: Marketability, but solved through public private partnership mode
Rice bean: Acceptability by the consumers

Significant achievements during 2010 and 2011:

Amaranth

- Popularized in Trichy district through FLD conducted at Kumulur; Distributed and sold 50 kg of amaranth seeds to the farmers for adaptation (TN)
- Seed of Suvarna (100 kg) and KBGA-1(20 kg) produced for distribution in Karnataka.
- Conducted 6 training programmes, about 400 tribal farmers of Nilgiris participated; 50 kg of seeds distributed among tribal farmers in Tamil Nadu and Karnataka.

Rice bean

- Popularized the crop in Trichy District through FLD at Kumulur; Distributed and sold 20 kg of rice bean seeds to the farmers for adaptation in Tamil Nadu.
- 30 kg seed of KBR-1 variety produced for distribution in Karnataka.
- Popularized the crop among 400 tribal farmers of Nilgiris through 3 training programmes funded under TSP; 20 kg of seed distributed among tribal people in Tamil Nadu.

FODDER CROPS

Table 8. Recommended varieties of forage crops for Karnataka, Tamil Nadu and Kerala

Crop	Variety	Adaptability (States/Region /Area)
Guinea grass (<i>Panicum maximum</i> Jacq.)	PGG-616	Southern zone
	Bundel Guinea- 2 (JHGG-04-1)	Karnataka, Tamil Nadu & Kerala
	Harithasree	Uplands and homesteads of Kerala
Black spear grass (<i>Heteropogon contortous</i>)	Bundel Lampa ghas-1 (IGHCO3-4)	Tamil Nadu and Karnataka
Sen grass (<i>Sehima nervosum</i>)	Bundel Sen -1 (IGS-9901	North-west Karnataka
Dhraf grass (<i>Chrysopogon fulvus</i>)	Bundel Phulkara-1 (IGC-9903)	North-west Karnataka
Napier-Bajra Hybrid	Suguna, Supriya	Southern district of Kerala
	RBN-13	Southern Zone
	Sampoorna (DHN-6)	Irrigated areas of Karnatka
Oats (<i>Avena sativa</i> L.)	Bundel Jai 2001-3 (JHO-2001-3)	Tamil Nadu and Karnataka
	Bundel Jai 2000-4 (JHO-2000-4)	Entire country except central zone

Table 9. Remunerative forage based cropping system

State	Agro climatic region and soil	Remunerative forage based cropping sequences
Karnataka	Humid, Red soil	Guinea grass / Congo signal grass (under coconut plantation)
	Tropical , Black soil	1. Napier Bajra hybrid (Perennial) 2. Maize(F) + Cowpea(F) – Lucerne
	Tropical humid, Red soil	Guinea grass / Congo signal grass (sole) / (under coconut plantation)
Tamil Nadu	Subtropical to tropical, Black soil	1. Napier Bajra hybrid (Perennial) 2. Sorghum(G) – Maize(F) + Cowpea(F)– Maize(G)
	Red soil	Guinea grass/ Congo signal grass (sole) / (under coconut plantation)
Kerala	Humid coastal zone	Rice – cowpea (Veg.)- Okra

OIL SEEDS AND PULSES

Oil seeds

Major oilseed crops of the region

Groundnut, soybean, sunflower, safflower and castor are the major oilseed crops of the region. Karnataka is the largest producer of sunflower (2.2 lakh tonnes from 4.1 lakh ha) accounting for 50% of the sunflower production in India. Other important crops of the state are: safflower second largest producer (0.41 lakh tonne from 0.57 lakh ha), groundnut (8.59 lakh ha) and soybean (8.59 lakh ha). Groundnut is a major crop of Tamil Nadu grown in an area of 4.35 lakh ha and produces 9.45 lakh tonnes.

Trends of area, production and yield of principal oilseed crops

The statistics on area, production and productivity of the major oilseed crops in the region during the period 2007 - 08 to 2010 - 11 are given in Annexure III. The perusal of the table indicates that Karnataka is the only state in this region which has the major area under oilseed crops. In Tamil Nadu, sunflower and castor are grown in limited area. Karnataka is the largest producer of sunflower, but there is a declining trend of sunflower area and production in the last three years. The productivity of safflower has decreased. Based on the reports of the yield, sunflower crop has great potential in Tamil Nadu.

Research support in the region

Coordinated Research Projects/Centres:

The list of coordinated projects/centers in operation in the region is given below:-

State	Name of Project	No. of centres	Name of centre
Karnataka	AICRP on Groundnut	3	Raichur, Dharwad, Chintamani
	AICRP on Sesame	1	Dharwad
	AICRP on Sunflower	2	Raichur, Bangalore
	AICRP on Safflower	1	Annigeri
	AICRP on Castor	1	Hiriyur
	AICRP on Linseed	1	Raichur
	AICRP on Soybean	2	Dharwad, Bangalore
Kerala	AICRP on Sesame	1	Kayamkulam
Tamil Nadu	AICRP on Groundnut	3	Vridhachalam, Ariyanagar, Bhavanisagar
	AICRP on Sesame	1	Vridhachalam
	AICRP on Castor	1	Yethapur
	AICRP on Sunflower	1	Coimbatore
	AICRP on Soybean	1	Coimbatore

Major achievements & package of practices

Oilseeds based cropping systems recommended for the region

Crop	Region / state	Recommended cropping systems
Sunflower	Northern region (Rainfed)	Rice-Fallow-Sunflower, Mungbean-Sunflower
	Northern region (Irrigated)	Cotton-Sunflower, Rice-Sunflower, Maize-Sunflower
	Tamil Nadu	Groundnut-Sunflower, Mungbean – Rice - Sunflower; Sunflower-Rice-Sesame
Castor	Karnataka / Tamil Nadu	Castor-Finger millet, Castor-Groundnut
Safflower	Karnataka	Mungbean-Safflower, Groundnut-Safflower, Hybrid Sorghum-Safflower, Soybean-Safflower
Sesame	Karnataka (Kharif, Summer)	Sesame-gram, Sesame-Kulthi
	Tamil Nadu (Kharif, Summer)	Rice/Groundnut – Sesame, Sesame-black gram, Sorghum-sesame

Oilseeds based Intercropping system recommended for the region

The recommended oilseeds based intercropping systems for the region are

Castor + Chillies (1:8)	Castor + Groundnut (1:5)
Castor + Pigeonpea (2:1)	Castor + Urdbean (1:2)
Chickpea + Safflower (3:1)	Coriander + Safflower (3:1)
Groundnut + Chilly (4:2)	Groundnut + Cotton (3:1)
Groundnut + Pigeonpea (4:1)	Groundnut + Sesame (4:1)
Groundnut + Sorghum (6:1)	Groundnut + Sunflower (4:2)
Pigeonpea + Sunflower (1:2)	Sesame + black gram (3:3)
Sesame+ green gram (3:3)	Soybean + Cotton
Soybean + Finger millet	Soybean+ Corn
Soybean+ Groundnut	Soybean+ Pigeonpea
Soybean+ Sugarcane	

Improved varieties of oilseeds recommended for the region

Crop	Recommended varieties/hybrids
Sunflower	DRSF 113, KABSH– 44(H), KABSH – 53(H), KABSH – 41(H), KABSH – 42(H), TNAU-SH-CO-2(H)
Castor	Jwala, DCH – 519(H), DCH – 177(H), YRCH – 1(H)
Safflower	PBNS – 40, NARI – 38, NARI –NH-15(H), NARI –NH-1(H)
Groundnut	AK 265, Ajeya, ICGV 00348, VRI (Gn) 7, VRI (Gn) 6, TGLPS 3, Vijetha Kadiri Harithandra.
Soybean	Hardee, KHSb 2, KB 79, PS 1029, MACS 124, MAUS 2 (Pooja), MACS 450, MAUS 61, Co-1, Co Soya-2, Bragg, CO3, RKS 18 and NRC 77
Sesame	DS-1, DSS-9, Kayamkulam-1, Thilothama, Thilak, Thilathara, Thilarani, TMV-3, TMV-4, TMV-6, SVPR-1, VRI-1, VS-9701, TMV-7.

Significant recent achievements related to the region

- During the last four years, one variety (DRSF-113) and two hybrids (KBSH-53 and TNAU-SH-CO-2) in sunflower, two safflower varieties (NARI-38 and SSF-658) and one variety (Jwala) and one hybrid (YRCH-1) in castor, NRC 77 of soybean, TMV-7 DSS-9 of sesame were recommended for this region.
- Dual inoculation of *Azospirillum* and *Azotobacter* as seed treatment can save 50% N for sunflower
- Identification of 'Groundnut + hybrid Bt cotton (3:1)' as the most remunerative intercropping system.
- Identification of two post-emergence weedicides viz., propaquizafop 10 EC and quizalofop ethyl 5 EC for effective control of grassy weeds in groundnut.
- Application of sulfur @ 30 kg and boron @ 0.5 kg/ha as a basal dose is recommended for achieving higher productivity of soybean in southern zone.
- For integrated nutrient management of soybean based intercropping systems, application of RDF + FYM @ 5 t/ha + zinc @ 5 kg/ha is recommended for Southern Zone.
- In-situ moisture conservation technique which includes conservation furrow after three rows of soybean (45 cm) is recommended for conservation of soil moisture and enhancement of productivity of soybean under rainfed conditions.

Major constraints for oilseeds production

- Erratic rainfall distribution with occurrence of drought in growing season
- Poor moisture conservation practices
- Timely availability of input, particularly quality seeds
- Occurrence of occasional epidemics of pests and diseases
- High humidity during seed formation stage limits the cultivation of soybean in coastal areas. High humidity during seed development and maturity stages results in germination of seeds in the pods itself
- Lack of suitable varieties of groundnut for late-sown conditions (delayed monsoon)
- Lack of early-maturing varieties of groundnut to suit different cropping patterns
- Lack of extra-early maturing high-yielding varieties of groundnut for rice fallows (residual moisture situations)
- Lack of varieties of groundnut with fresh seed dormancy to avoid in-situ germination due to early onset of monsoons coinciding with harvest time.
- Regular occurrence of soybean rust especially in North Karnataka. In order to cope up with the problem, the farmers resort to preventive application of recommended fungicides, which add to the production cost.
- The hot and the humid conditions are conducive for harbouring insects and diseases.

Any other suggestion for the region

- There is need for phasing out of old and inferior varieties by enhancing availability of quality seed of new varieties to the farmers
- Application of Polythene Mulch Technology (PMG) in seed plots during rabi/summer season to facilitate early sowing and enhancing productivity in groundnut.

Pulses

Major pulse crops of the region

Pigeonpea, chickpea, mungbean, urdbean, cowpea and horsegram are the major pulse crops being grown in the region.

Trends of area, production and yield of major pulse crops

The statistics on area, production and productivity of the major pulse crops in the region during the period 2007-08 to 2010-11 are given in Annexure IV. Chickpea and pigeonpea are the most important pulse crops of Karnataka grown in 1.2 million ha area in addition to urdbean and pigeonpea.

Research support in the region

i. **Institute and Regional Station:** Regional Research Station, IIPR, Kanpur at UAS, Dharwad has been established for pulses.

ii. **Coordinated Research Projects/Centres:** The list of coordinated projects/centers in operation in the region is given below:-

State	Name of Project	No. of centre	Name of centre
Karnataka	AICRP on Chickpea	2	Gulberga, Bangalore
	AICRP on Pigeonpea	2	Gulberga, Bangalore
	AICRP on Mullarp	1	Dharwad
	Arid Legumes	1	Bangalore
Tamil Nadu	AICRP on Pigeonpea	2	Coimbatore, Vamban
	AICRP on Mullarp	2	Coimbatore, Vamban
Kerala	Arid Legumes	1	Pattambi

Major achievements & package of practices

Pulses based cropping systems / intercropping systems: Pigeonpea + mungbean / urdbean / cowpea (1:1); Pigeonpea + groundnut (4:2)

Improved varieties of pulses recommended for the region

Chickpea	JG 11, ICCV 10, CO3, CO 5, Phule G 95311 (K), Phule G 0517 (K), MNK-1 (K)
Pigeonpea	TTB7, TS 3, Maruti (ICP 8863), Asha, Hy 3C, BRG 1, BRG 2, WRP 1, Vamban 1, Vamban 2, Co 6, Hy 3C, LRG 30, Vishakha, Pragati, Asha, CORG 9701
Mungbean	COGG 912, OUM 11-5, CO 3, CO 4, ML 131, Vamban 1, ADT 3, CO 5, Pusa 9072, IPM 02-14, PKV AKM 4, HUM 1
Urdbean	KU 301, WBG 26, Vamban 2, Pant U 30, TU 94-2, WBU 108, IPU 2-43, LU 391, VBG 4 – 008, DU 1
Horse gram	CRIDA- 1-18R, BJPL – 1
Cowpea	KM-5, IT-38956-1

Significant recent achievement related to the region

- IPM 2-14 variety of mungbean and LU 391 and VBG 4-008 varieties of urdbean have been recently released for cultivation in the region.
- High yielding desi variety (JG 11) and Kabuli varieties (Phule G 95311, Phule G 0517, MNK-1) have been recently released for cultivation in the region.
- TTB 7, PT 221, GS 1, HY 3C, BRG 1, BRG 2 and WRP 1 varieties for Karnataka and CORG 9701 and VRG 3 for Tamil Nadu have been released recently.

Major constraints for pulses production

- Cultivation of pulses on rainfed, marginal and sub marginal lands.
- Erratic and untimely rainfall; high humidity and cloudy weather at flowering results in flower drop.
- Weeds are great menace, particularly during kharif season.
- In the delta region, the major bottleneck is sandwiching of pulses crops in between two main crops of the paddy. Mungbean and urdbean crops suffer due to water logging in November/December.
- Lack of drought tolerant varieties in chickpea
- Problem of wilt and Helicoverpa exists in this region
- Terminal moisture stress, wilt, sterility mosaic, pod fly & pod borer complex in pigeonpea

COMMERCIAL CROPS

Important crops in the region:

Sugarcane, cotton and tobacco are the major commercial crops grown in this region. Mesta is also grown to a small extent in Karnataka.

Area, Production and Productivity:

The details regarding the area, production and productivity during the last five years is given Annexures V – VII.

Research support in the Region:

Details are given Annexure VIII

Cotton

Recommended varieties / hybrids:

Karnataka: Sahana, Jayadhar, DCH 32, DHH 11, DHB 105, RCH 2, Bunny, Mallika.

Tamil Nadu: MCU 5, MCU 5 VT, LRA 5166, Sumangala, Surabhi, SVPR 2, SVPR 3, MCU 7, MCU 12, MCU 13, KC3, DCH 32, TCHB 213, RCH 2, Bunny, Mallika.

New varieties / hybrids identified:

Varieties: Suraj, RAH 100, DLSA 17, SVPR 4, ARBH 813

Hybrids: Suvidha, DHB 915, RAHB 87, RAHH 95

Private Bt cotton hybrids released for the Region: Several Bt cotton hybrids, both intra hirsutum and interspecific, have been approved for commercial cultivation by GEAC.

Disease / pest problems:

Karnataka:

Among various sucking insect pests, leafhopper was at higher level in Karnataka state during crop season. Thrips population was at above threshold level from last week of August to second week

of October in Dharwad. Mealy bug infestation was observed in Raichur from third week of October to second week of January. Dharwad centre had higher population of mirid bug, while it was at moderate level in Raichur.

In Raichur, *Helicoverpa* population ranged from 0.4 to 1.9 per 5 plants, while in Dharwad, it was at higher level ranging from 2.6 to 13.0 almost throughout the cropping season. *Earias* bollworm was almost nil in Raichur, while it was at moderate level of 0.2 – 6.1 per five plants almost throughout the season at Dharwad. Dharwad and Raichur centres recorded very high population of pink bollworm larvae in the sampled green bolls. It ranged from 6.0 to 23.0 in Dharwad and 4.0 to 24.8 in Raichur during October to Mid-January.

During the season *Alternaria* blight and Grey mildew were prominently found in many places of survey ranging from 5-30 per cent followed by bacterial blight (5-15 per cent) in Karnataka.

Tamil Nadu:

In Coimbatore, population of pink bollworm larvae was at low level of 1 to 3 during December - January months. No pink bollworm adults were observed in the installed pheromone traps. Incidence of larval stages of *Spodoptera litura* or *Earias* sp. was not observed during the entire crop season. Larval incidence of *Helicoverpa armigera* was very meager.

Survey for the occurrence of cotton diseases in Tamil Nadu revealed that a maximum of 15.6% incidence of Fusarial wilt was observed in Coimbatore, followed by 8.5% incidence in RCH Bt grown in Kallakurichi of Villupuram district. *Alternaria* leaf blight was severe in Koonor of Kannivadi block in Dindigul district. The incidence of TSV and LCV was observed to an extent of 2% in TNAU farm at Coimbatore.

Important package of practices:

The package of practices have been developed and recommended separately for irrigated tracts, rainfed tracts, rice fallow cotton tracts and so on after fine tuning. Important recommendations include cultivation of high yielding varieties and hybrids especially ELS Cotton varieties, date of sowing, soil test based fertilizer application, integrated nutrient management, spacing, inter cultural operations, weed management, integrated pest management, integrated disease management etc. by the concerned State Agricultural University and are followed by the State Department of Agriculture.

Seed production

The breeder seed production in respect of both varieties and hybrids were organized by the concerned State Agricultural University and CICR, Regional Station, Coimbatore and there is no mismatch between indent and production.

Major constraints:

About 40 % of total textile mills of the country are situated in the state of Tamil Nadu and the state is the major consumer of cotton lint. But the area and production in the state is very low and hence the mills are compelled to import cotton bales from neighbouring states. This ultimately leads to heavy expenditure on transport of cotton bales alone. The Government of Tamil Nadu is making sincere efforts through State Cotton Council to bring more area under cotton cultivation. Labour shortage for field operation is a major constraint.

Suggestions for improvement:

Since there is great demand for *desi* cotton especially for non-textile purpose, more area may be brought under *desi* cotton. Suitable steps are needed for bringing in additional area under *desi* cottons, especially *G. herbaceum*, in coastal areas of Karnataka. Some mills undertake contract farming for their specific requirement like ELS cotton for export purpose. They take technical guidance from CICR (ICAR) and TNAU, Coimbatore. Transgenic ELS variety (Suvin Bt) is

the need of the hour so that more farmers can be encouraged to grow the super fine quality cotton.

Sugarcane

Varieties

State	Early	Midlate
Kerala	Co 0314, Co 0403, CoSnk 05103-	Madhuri,Thirumadhuram,Madhurima, Madhumathi, Co 86032, Co 99004, Co 2001-13, Co 2001-15, Co 0218, CoSnk 05104
Karnataka	CoC 671, Co 0314, Co 0403, CoSnk 05103	Co 62175, Co 7804, Co 8371, Co 86032, Co 99004, Co 2001-13, Co 2001-15, Co 0218, CoSnk 05104
Tamil Nadu	Co 0314, Co 0403, CoSnk 05103 For coastal region CoC 90063, CoC 01061, CoSi 6 CoOr 03151, CoA 03081	CoC (SC) 22, CoG 5, Co 86032, Co 99004, Co 2001-13, Co 2001-15 Co 0218, CoSnk 05104 For coastal region: CoA 05322, CoA 05323

Disease / Pest problems

- Red rot is a major disease in coastal Tamil Nadu. Besides, smut, wilt and yellow leaf disease (YLD) in Tamil Nadu; smut, rust, eye spot and YLD in Karnataka were prevalent in severe forms. In Kerala, diseases are not a major problem.
- For management of red rot, varietal resistance and healthy seed production are the most effective method. In Kerala and Tamil Nadu, monitoring on appearance of new pathotypes is being done and in coastal Tamil Nadu four pathotypes have been identified. A number of varieties resistant/moderately resistant to red rot and smut have been identified. Karnataka is free from red rot.
- In Karnataka and Tamil Nadu, woolly aphid is now under control mainly due to natural predators. Two woolly aphid resistant varieties viz., CoSnk 05103 (early) and CoSnk 05104 (midlate) have been identified in 2011. Early shoot borer and internode borer are the major pest of the region. Internode borer is effectively controlled by biocontrol agent, *Trichogramma chilonis*.

Important package of practices

- Agronomy for new varieties: Promising genotypes should be adopted to replace existing old/low yielding varieties. Sugarcane crop in Peninsular zone may be fertilized with 25% more NPK over recommended dose of NPK. In peninsular zone DAP is superior to SSP as a phosphatic source of fertilizer and sugarcane crop be fertilized with 60-80 kg P₂O₅/ha. In zinc deficient soil, 20-30 kg ZnSO₄/ha is sufficient.
- Developing organic farming module for sugarcane crop: For sustaining higher sugarcane yield and better soil health, sugarcane plant and ratoon crops be fertilized with 75% of recommended NPK through inorganics + 25% of recommended N through organics (FYM/PSM) along with furrow application of Azotobacter + PSB @ 2.5 kg/ha each and biopesticide (*Trichoderma*) inoculated @1 kg/ha mixed with one quintal FYM; apart from trash mulching and green manure of legumes (*Sesbania*) in alternate rows in ratoon crop.
- Control of flowering in commercial cultivation of sugarcane: Wherever there is problem of flowering, foliar spray of ethrel @ 250 - 300 ppm (2.5 – 3.0 ml/10 l water) at 4 months stage of the crop should be followed in suppressing flowering.

- Sub-soiling on soil physico-chemical characteristics and sugarcane productivity: Sub-soiling especially cross sub-soiling at 1.0 m is recommended for enhancing cane yield and sustaining soil health.
- Weed management in sugarcane ratoon crop: Three hoeings, at 1, 4, and 7 weeks after ratoon initiation should be adopted for effective control of weeds in sugarcane ratoon crop. However, under limitations of manpower-availability, cost etc., pre emergence application of either of atrazine @ 2.0 kg a.i./ha or metribuzin @ 1.0 kg a.i./ha(800- 1000 litre water/ha) followed by either of 2,4 D Na salt @ 1.0 kg/ ha(600-800 l water/ha) or hoeing at 45 days after ratooning can be successfully practiced. Further, trash mulching in alternate rows and hoeing in unmulched furrow at 1 & 6 weeks after ratoon initiation is also a good option.
- Management of smut disease: Dipping of setts in Carbendazim (0.2%) for 30 min before planting provides effective protection from sett-borne infection of smut.

Seed Production

Breeder seed of improved varieties of sugarcane was raised in Tamil Nadu and Karnataka and 2133 and 5100 q of Breeder Seed, respectively, was produced.

Major Constraints

- Inadequate supply of organic matter and nutrient depletion in soil, resulting into poor soil productivity.
- Lack of technology for combating drought situations.
- Inadequate availability of quality seed cane of improved varieties to growers.
- Red rot continued to be a major threat in coastal Tamil Nadu for the successful cultivation of sugarcane, especially high sugar varieties. Yellow leaf disease is assuming problem in some varieties under cultivation.

Suggestions for improvement

- Soil fertility status should be improved by adoption of suitable agro technology particularly Integrated Nutrient Management which comprises application of NPK, micronutrients, biofertilizers FYM/sulphitation press mud cake, trash besides green manuring.
- Ratoon management technology should be used for increasing ratoon productivity by integrating stubble shaving, gap filling, trash mulching and cultivation in alternate rows with application of phorate.
- Strengthening of quality seed production programme in the region for the availability of certified seed to growers.
- Monitoring on appearance of new pathotypes of red rot pathogen should be done and varietal screening for red rot resistance should be strictly followed. Management of smut should be followed for sustaining susceptible varieties.
- Identification of potential biocontrol agents for key pests of the region. Field release of parasites/predators for which technology has been perfected.

Tobacco

Karnataka FCV tobacco

The Hunsur Research station of CTRI has released zone specific varieties to cater to the needs of farmers of varied rainfall zones. The varieties are: Swarna (powdery mildew resistance for the heavy rainfall zone), Bhavya (Black shank resistant and tolerant to root-knot and frog eye diseases for the assured rainfall areas), Kanchan (Black shank resistant) and Rathna (Black shank resistant for low to medium rainfall areas). At present variety Kanchan is grown in around 90% of

the total KLS area. The AINRPT Centre at Shimoga has released the varieties Thrupthi (KST-19) and Sahyadri (KST-28).

Karnataka bidi tobacco

The *Bidi* tobacco variety Vedaganga-1 has been developed and recommended for cultivation in Nipani area during 2007. The other varieties recommended are S-20, NPN-190, PL-5, Bhagyashree, Bhavyashree and Anand-119.

Tamil Nadu chewing tobacco

Twenty two varieties with high yield potential and good quality have so far been released for commercial cultivation in Tamil Nadu as listed below.

Chewing tobacco:

Sun-Cured	Smoke-cured	Pit-cured
I-64, VTK-1	PV-7	VD-1
I-115, VR-2	Thangam	Vairam
Bhagyalakshmi	Maragadham	
Meenakshi, Meenakhi CR		
Abirami, KavIri		

Cigar filler: Shade-cured: KV-1, VV-2 and Krishna

Country cheroot Tobacco:

Sun-cured: I.737, Bhavani Special, Sangami, OK-1 and Sendarapatty Special

Karnataka FCV tobacco

Identified FCV variety FCH 222 for has been released for cultivation in wilt endemic areas in KLS. This new variety was found moderately resistant to black shank disease with a yield potential of 2,200 kg/ha.

Karnataka BIDI tobacco

Bidi tobacco variety NBD-209 is under farm trial during the year 2011-12.

Tamil Nadu chewing tobacco

- One high yielding chewing tobacco hybrid variety VDH-3 was identified for release during 2010 This has yield of 4116 kg/ha an increase of 13.0% over the best check Abirami
- Selection HV. 2009-3 recorded significantly highest cured leaf yield of 4253 kg/ha against the controls Bhagyalakshmi and Abirami (2009-11).
- F1-8 (A.145 X NP-19), F1-2(A.119 X NP-19) and F1-15 (NP-19 X GT-8) with the seed yield potential of 1442, 1398 and 1259 kg/ha were found promising under 60cm x 50 cm spacing.

Seed production

Karnataka FCV tobacco

- FCV variety Kanchan is being produced with high genetic purity and supplied to registered growers of KLS.
- CTRI RS, Hunsur produced seeds of improved tobacco varieties (Bhavya, Rathna and Kanchan) and supplied to registered tobacco growers
- AINRPT, Shimoga produced seeds of improved tobacco varieties (Thrupthi (KST-19), Sahyadri (KST-28)) and supplied to farmers
- *Bidi* tobacco seed and seedlings were produced at Nipani and supplied to farmers

- The CTRI Research Station, Veda sandur is the only agency mandated to meet the entire seed requirement of the tobacco farmers of Tamil Nadu. It produces seeds as well as seedlings.

Major constraints:

Karnataka

- Being a rainfed crop, the productivity of FCV tobacco is largely determined by the rainfall amount and distribution
- The difficulties in post-harvest management owing to lack of conditioning and bulking sheds/storage facilities, which results in deterioration in the quality of the leaf
- Increasing cost and the timely availability of important inputs like labour and fire wood.
- Decreasing soil productivity owing to poor organic applications, imbalanced nutrient application and poor soil and water conservation measures.
- Lack of high yielding varieties / hybrids tolerant to biotic and abiotic stresses (e.g. Black shank disease nematodes etc.).
- Lack of economic and eco-friendly IPM modules for major pest and diseases to reduce agrochemical residues below the Guidance Residue Levels (GRL).
- Lack of technology for mechanization of tobacco cultivation.
- Occurrence of irregular, unusual rains affecting yield and quality causing reduction in area under bidi tobacco

Tamil Nadu -

- Delay in onset of monsoon leading to delayed planting and reduction in productivity of Chewing tobacco.
- Pests and Diseases: Tobacco caterpillar in the inland areas and black shank in the coastal belt causing severe losses.
- Price fluctuations due to unorganized markets are also adversely affecting the farmers.
- Non-availability of quality wrapper leaf, trained manpower, lack of finance and lack of adequate market intelligence is also reducing cigar production units.

TNAU COIMBATORE

New Crop Varieties Released during 2010 & 2011

1. **TNAU RICE CO 50:** Medium slender rice; High head rice recovery; Intermediate amylose content; Suitable for rice and idly making; Moderately resistant to blast, sheath blight, brown spot, bacterial leaf blight and rice tungro disease.
 Duration: 130 – 135 days
 Season: Late samba / Thaladi
 Yield: 6338 kg/ha. [10.11% increase over ADT(R)46]
2. **TNAU RICE TRY 3:** Highly suitable for Idly making; Moderately tolerant to sodicity; Medium bold grain; High Milling (71.3%) and Head Rice Recovery (66.0%); High outturn of rice flakes (82.2%); Resistant to leaf folder, stem borer and brown plant hopper; Resistant to blast, brown spot, sheath rot and sheath blight.
 Duration: 135 days
 Season: Samba / Late Samba / Thaladi
 Yield: 5833 kg/ha (10.8% over ADT (R) 46, 22.0% and 13.0%)

- 3 **TNAU Rice ADT 49:** Medium slender, white rice; 1000 grain weight - 14.0 g; Head rice yield - 71.3%; Non-sticky cooked rice; Moderately resistant to blast, sheath rot, sheath blight and resistant to RTD under artificial conditions; Moderately resistant to leaf folder and brown spot under field conditions.
 Duration: 130 to 137 days
 Season: Late samba / Thaladi
 Yield: 6173 kg/ha (10.5% over BPT 5204)
- 4 **TNAU Rice Hybrid CO 4:** Medium duration hybrid with medium slender white rice; Intermediate amylose content with high linear elongation ratio on cooking; Resistant to blast, brown spot and moderately resistant to WBPH, GLH, sheath blight, sheath rot and RTD.
 Duration: 130 – 135 days
 Season: Late samba / Thaladi
 Yield: 7348 kg/ha (14% over 27 P11)
5. **TNAU WHEAT COW 2:** Suitable for timely and late season conditions; Semi-dwarf; Non – lodging; Non – shattering; Reddish attractive grains (β -carotene-3.7 ppm); Quality grains (Protein -13.2%); Resistant to black, yellow and brown rusts.
 Duration: 110 days
 Season: 15th October to 15th November (Sowing)
 Yield: 4040 kg/ha (26.6% increase over NP 200)
6. **TNAU SORGHUM CO 30:** Dual purpose variety suited for grain and fodder; Dry fodder with high dry matter digestibility; moderately resistant to shoot fly and stem borer; Resistant to downy mildew; Creamy white grains.
 Duration: 100 - 105 days
 Season: Rainfed: June – July, Sep. - Oct.; Irrigated: February-March
 Yield: Rainfed Grain 2800 kg/ha, Dry fodder 6990 kg/ha
 Irrigated: Grain 3360 kg/ha, Dry fodder 9290 kg/ha
- 7 **TNAU Sorghum Hybrid CO 5:** Short duration, dual purpose hybrid; Non-lodging; Dry fodder with high dry matter digestibility; moderately resistant to shoot fly and grain mould; Semi loose ear heads with white grains.
 Duration: 95 - 100 days
 Season: June-July, Sept.-Oct., Feb.-March
 Yield: Rainfed: Grain 2769 kg/ha; Dry fodder 7563 kg/ha
 Irrigated: Grain 4338 kg/ha; Dry fodder 10548 kg/ha
8. **TNAU Cumbu Hybrid CO 9:** High grain yield; High tillering (4-6 tillers); Compact earhead and bold grain; High iron content (8mg/100g); Highly resistant to downy mildew and rust.
 Duration: 75 - 80 days
 Season: Irrigated: (Jan-Feb; March-April); Rainfed: (June-July; Sep-Oct)
 Yield: Irrigated: 3728 kg/ha; Rainfed: 2707 kg/ha
9. **TNAU Blackgram CO 6:** Short duration; determinate plant type and non-shattering of pods; Bold seed with mean 100 seed weight of 5.5 g; Good batter qualities and organoleptic traits; Moderately resistant to yellow mosaic virus, stem necrosis and root rot; Field tolerance to aphids, stem fly and spotted pod borer.
 Duration: 60 - 65 days
 Season: September – October
 Yield: 733 kg/ha [13% increase over VBN (Bg) 4 and 12.0% increase over VBN(Bg)5]

10. **TNAU Blackgram VBN 6:** Non lodging, non-shattering, determinate; Resistant to YMV, powdery mildew; Suited for both irrigated and rainfed situation; 21.1% protein content.
 Duration: 65 -70 days
 Season: June - July, Sept. - Oct. and Feb.- March
 Yield: Average yield: 871 kg/ha [15.8% over VBN (Bg) 5]
11. **TNAU Groundnut CO 6:** Tolerance to drought; Bunchy pods; Shelling out turn - 73.5 %; Oil content - 49.5 %.
 Duration: 125 – 130 days
 Season: Rainfed (May – June)
 Pod yield: Rainfed: 1914 kg/ha
12. **TNAU Sunflower Hybrid CO 2:** High oil content (39.8 %); High volume weight (48g/100ml)
 Duration: 85-90 days
 Season: Kharif and Rabi / summer
 Yield: Kharif: 1950 kg/ha; Rabi / Summer: 2230 kg/ha
13. **TNAU Sugarcane SI 7:** High yielder and high quality cane; Good ratooner; Easy to detrash; No spines; Non flowering; Tolerant to drought and late water logging; MR to red rot disease
 Duration: 11 months
 Season: Early
 Yield: Plant cane - 154 t/ha; sugar - 20.5 t/ha
 Ratoon cane - 146 t/ha; sugar – 19.4 t/ha

Management Technologies

- **TNAU indigenous sex pheromone lure for YSB management in rice:** Sex pheromone molecules synthesized by IICT, Hyderabad and formulated at precisely to suit to the local geographical population
- **Processing and value addition of sugarcane syrup:** A unique natural product, free of chemical clarificants. An alternative natural sweetener in place of refined sugar and other sweeteners
- **Multigrain adai mix:** Millets and pulses mixed in proportion to form adai mix with better nutritional quality and shelf life (6 months)
- **Integrated pest and disease management (IPDM) package for silkworm, *Bombyx mori* L.:** Management package for *Grasserie*, *Flacherie* and *uzifly*.
- **Designer micronutrient fertilizer mixtures:** for sugarcane, cotton, groundnut, sesame, sunflower & castor

University of Agricultural Sciences, Bengaluru

Varieties released

- **Rice KMP-105:** Semi dwarf and short duration (110-115 days) variety, suitable for August-September planting. The variety is tolerant to blast, grains are medium slender with good quality and yields about 55 to 60 q/ha. It is recommended for irrigated areas of Zones-6 & 7.
- **Paddy-JGL-1798:** This variety has duration of 130 - 135 days and yield potential of 62-67 q/ha. It is a fine grain variety equivalent to BPT – 5204 and fetches high price in the market. It is suitable for Kharif as well as summer and recommended for cultivation in Zones 6 & 7.

- **Paddy-KHP-11:** It has a duration of 150 - 155 days and yield potential of 48-50 q/ha. It is blast tolerant and non-lodging. Recommended for midland situation of Zone 9.
- **Paddy-KHP-12:** It has duration of 175 - 180 days and yield potential of 50 – 52 q/ha. The variety is blast tolerant and non-lodging. Recommended for lowland situation of Zone 9.
- **Maize hybrid - NAH-1137:** It matures in 120 days and has grain yield potential of 100-105 q/ha and green fodder yield of 38 t/ha. It is tolerant to downy mildew, turicum leaf blight and polysora rust. It has got 'stay green' character, so that, farmers can harvest both matured cobs and green fodder. It is recommended for cultivation in Zones 4, 5, 6 & 7.
- **Groundnut - Chintamani-2 (KCG-2):** High yielding variety with an average seed yield potential of 23 q/ha and has recorded 35 % higher yield compared to check, TMV-2. It matures in 110 - 115 days. It has shelling percentage of 71 and oil content of 46 percent. The variety is moderately tolerant to major diseases like leaf spot, rust and peanut stem necrosis and for pests like leaf miner. It is recommended for cultivation in Zones 4 & 5.
- **Soybean: MAUS-2 (Pooja):** Seed type variety with duration of 105-115 days and yield potential of 22 q/ha and gives 12 % higher yield compared to the check Hardee. It is suitable for Kharif under rainfed situation and suitable for sowing during first fortnight of July. It is recommended for cultivation in Zone 5.
- **Sugarcane-CoVC-99463:** It has duration of 12 - 14 months and yield potential of 170 - 180 t/ha. This variety is suitable for July-August & October-November planting and wide row spacing. Recommended for irrigated area of Zones 6 & 7.
- **Hybrid Castor-DCH-177:** This variety has duration of 90 - 150 days (4 pickings) and yield potential of 15.75 q/ha. It gives 35 % higher yield over the check, GCH-4 and resistant to Fusarium wilt and white fly. It is recommended for Zones 4 & 5.
- **Fodder Sorghum-CoFS-29:** This variety has yield of 669 q/ha (green fodder) and 174 q/ha (dry matter yield). The variety is recommended for Southern Karnataka.

Agricultural Entomology

- Buprofezin 25 SC @ 700 ml/ha proved effective in controlling Brown Plant Hopper in paddy with BC ratio of 5.2 compared to imidacloprid and chloropyriphos at V.C. Farm, Mandya.
- IPM for chickpea has been developed for inclusion in the Package of practices.
- Maize seeds can be treated with spinosad 45 SC @ 0.04 ml mixed in 5 ml of water per kg of seed to control the storage insect pests upto nine months.
- Seed treatment of cowpea with Emamectin benzoate 5 SG @ 40 mg or Spinosad 45 SC @ 0.04 ml diluted in 5 ml of water per kg of seed to control the pulse beetle in storage upto 12 months.
- Diafenthuiran 50 WP 1.2 g/l and propargite 57 EC 0.5 ml /l are effective are for control of arecanut mites in addition to dicofol 20 EC ml/l and wettable sulphur 4 g/l.
- Poison bait made of 400 ml of water + 1 kg rice bran + 200 g of jaggery + 10 g Methyomyl, mixed thoroughly and allowed for one and half days for fermentation is found effective in management of Giant African Snail. The poison bait is more effective when spread around the plots during evening hours for control of Giant African Snail in Zones 4, 5, 6, 7, 9 & 10.
- Application of Flubendiamide 20% WG @ 150 g/ha and 48SC @ 50 ml/ha was found effective in management of yellow stem borer & leaf folder in paddy with a cost benefit ratio of 1:4.20 and 1:4.16, respectively at Mandya.

- Application of Fenazaquin 10EC @ 1.7 ml/l followed by wettable sulphur 80 WP @ 3 g/l was found effective in management of yellow mite in potato in Zone 6.
- Pentomid bug in arecanut can be effectively managed by the application of chloropyriphos 20 EC 3 ml/l and monocrotophos 36 SL 1.5 ml/l in Zone-7.
- Arecanut borer can be managed effectively by spraying Othiodicarb 75WP 2 g/l or indoxicarb 14.5 SC @ 0.5 ml/l during August / September in Zone-7.

Management of Diseases

- Spraying of wettable sulphur 80 WP @ 0.3% or Difenoconazole 25 EC @ 0.05% as soon as the symptoms are seen and if necessary at 15 days interval is effective in controlling powdery mildew in sunflower.
- Spot application of well decomposed poultry manure at 50 kg/plant at 4 inches away from the plant at the time of planting was found effective in controlling root knot nematode in FCV tobacco.

Home Science

- Multipurpose ready to cook health mixes - Nutri mix, Idli mix and Vada mix containing 50% maize along with other ingredients can be stored for three months at room temperature without any change in biochemical, microbial and organoleptic qualities in polyethylene and aluminum cover.

Breeders Seed and Quality seed produced

- In line with the State Government's policy of increasing the seed production three fold to provide quality seeds to the farmers of the State, the University is planning to increase seed production from 47,000 to 74,000 q in the next three years. Quantity of Breeders seed and Quality seed produced during the last two years is listed below.

Seeds Produced during 2009-10 and 2010-11 (Quintals)

Crop	2009-10		2010-11	
	Breeders Seed	Quality Seed	Breeders Seed	Quality Seed
Cereals	534	28586	524	22600
Pulses	351	742	603	2924
Oilseeds	1888	13671	5206	12903
Vegetables	-	-	-	85
Total	2773	42999	6333	38512

University of Agricultural Sciences, Dharwad

The following six varieties were accepted for release during 2011.

1. Coccina (DRC-2)
2. Hybrid cotton (DHH-263)
3. Sorghum (AKJ-1, KMJ-1, SMJ-1 and RSJ-1).

University of Agricultural Sciences, Raichur

Status of Varieties released in the last three years

- **TS-3R Pigeonpea:** This variety has high yield potential of 14-18 q/ha. The variety resistant to wilt and sterility mosaic is a replacement to Gulyal local genotype. Easy to identify off types during seed production. The duration of the variety is 145-155 days and is recommended for cultivation in zone 2 of the state.
- **RSFV – 901, Sunflower:** This variety has high seed yield of 15-20 q/ha and oil yield of 50% over check Modern. The variety has high oleic acid content of 66 – 79%. It is found to be resistant for rust and tolerant to SND and Downy mildew and Powdery mildew diseases. The variety matures in 95 – 100 days period and is recommended for zone 1 & 2.
- **PTR – 6, Tomato:** This variety is recommended for zones 1 & 2 for processing purpose. Fruits are medium in size, has yield potential of 40-45 t/ha. The variety has a blend of sugar acid and matures in 120 days period and is tolerant to early blight and leafcurl disease.
- **Paddy, GGV-05-01 (IET-20594):** This variety is high yielding and cultivated both in Kharif and summer seasons. Medium slender grain and matures in 130 - 135 days. Recommended for zones 2 & 3.
- **Finger Millet DHRS-1:** This variety is high yielding and recommended for zone 3.
- **Chickpea MNK-1:** This variety is high yielding

Kerala Agricultural University, Thrissur

- The following varieties were released for cultivation in the state by the State Seed Committee on Crop Standards and Release:

Rice	: Thulam, Prathyasha, VTL-8, Vyshak, Samyuktha, Ezhome -1, Ezhome - 2
Cowpea	: Hridya and Sreya
- Identified two promising rice cultures viz. Jaiva and Ezhome-3 tolerant to salinity and one rice culture Sampada (IET 19424) for higher yield. The above cultivars are in the advance stage of release.
- In pulses, three promising horse gram varieties KS-2, AK-41 and AK-42 and cowpea cultures RC-101 and GC-3 are in the advance stage of release.
- GI registration obtained for two Wayanad rice cultivars, Jeerakasala Rice, Gandhakasala Rice and a unique sugarcane product Central Travancore Jaggery
- Documentation of Kaipad organic rice production tract was completed and application for getting Geographical Indication tag for Kaipad rice was filed.
- Two TGMS lines, TS29-1 and TS29-2 which were uniform in the expression of pollen sterility in plains and fertility in higher altitudes were identified for use in breeding for two- line hybrids in rice
- The levels of proline and peroxidase activity under saline stress condition can be used as molecular markers in screening for salinity tolerance.
- Morphological and biochemical characterization of aromatic rices of Wayanad was done
- Seeds and planting material production of improved varieties/cultures/clones was intensified in 35 production units the University besides organic manures and bio-control agents.
- During 2010-11, seeds, planting materials, organic manures, biocontrol agents etc. worth Rs. 557.60 lakhs were produced in 35 production centers.

- Paddy seeds – 439 kg
- Coconut seedlings- 1,23,527
- Arecanut – 1,17,644 seedlings
- Vegetable seeds – 4662 kg
- Pepper – 6,90,286 rooted cuttings
- Mango- 1,19,715 grafts
- Banana- 1,15,204 suckers
- Cashew – 1,23,476 grafts
- Biocontrol agents – 44702 kg

SUGARCANE BREEDING INSTITUTE, COIMBATORE

Salient research achievements

- ◆ A midlate maturing variety Co 0218 was released for commercial cultivation in 2010. This is a high sugared variety with average cane yield of 104.53 t/ha, sugar yield 15.3 t/ha and juice sucrose 20.63 % at 12 months. This clone is moderately resistant to red rot, tolerant to drought and salinity and possesses A₁ quality jaggery.
- ◆ Co 0403, an early maturing variety was identified in 2010 by Varietal Identification Committee. This variety recorded sugar yield of 13.29 t/ha, cane yield of 101.46 t/ha and sucrose % juice of 18.16 % at 10 months. It is resistant to red rot and smut diseases and also possesses A₁ quality jaggery.
- ◆ Nineteen promising early clones and 33 midlate clones of sugarcane from the Institute are in different stages of multi-location trials under AICRP.
- ◆ Out of 59 promising clones for Peninsular zone identified as 'Co' canes, 11 early maturing clones and 13 midlate maturing clones were accepted for evaluation under AICRP programme during this period.
- ◆ The breeder seed of sugarcane varieties Co 86032, Co 94008, Co 94012, Co 2001-13 and Co 2001-15 were produced and distributed, which included 127 tonnes of seed cane and 43,800 tissue culture plants.
- ◆ A confined field trial of ten sugarcane transgenics with resistance to early shoot borer was conducted with the approval of RCGM.
- ◆ A new gene promoter from wild rice was cloned and characterized. It gave higher gene expression than the available constitutive promoters in monocots, especially sugarcane. Patent application was made for this gene.
- ◆ The microsatellite markers generated in sugarcane were used for identifying trait specific markers for red rot resistance and top borer resistance. Genus specific and species specific molecular markers could identify true interspecific and intergeneric hybrids involving sugarcane.
- ◆ Hybrids developed with *Erianthus* or *S. spontaneum* cytoplasm were identified by chloroplast or mitochondrial DNA polymorphism and were further backcrossed to develop near commercial sugarcane varieties with alien cytoplasm.
- ◆ In the plant crop, drip fertigation saved 41% of irrigation water and gave 9.4% higher cane yield than furrow irrigation.
- ◆ *Screening for red rot resistance:* Under field conditions, 232 entries were identified as R/MR by plug method and 147 were identified as R by nodal method.
- ◆ Emergence of new virulent isolates of red rot from Co 94012 (Gujarat and Tamil Nadu), Co 6907 (Orissa), Co 91017 and PI 96-843 (Tamil Nadu), CoS 8436 and BO 138 (Sub tropical region) was found during this period.

- ◆ **Management of red rot:** Under field conditions, overnight soaking in the product of trifloxystrobin- 25% + tebuconazole - 50% individually or in combination with Thiophanate methyl 70WP was found to be effective to protect the crop from soil borne inoculum of red rot and such treatments improved plant survival and millable canes.
- ◆ **Molecular basis of red rot resistance:** By DD-RT-PCR and RACE identified candidate genes viz. chitinase, 14-3-3-like protein, xylanase inhibitor protein, chitinase, leucine rich repeat family protein, basal layer antifungal peptide, actin depolymerising factor and putative hydroxyproline-rich glycoprotein for red rot resistance in sugarcane.
- ◆ **Sugarcane stalk tissue proteome** - By subjecting 30 selected stalk specific protein spots to eLD-IT-TOF-MS/MS analysis, a reference map has been established for sugarcane stalk tissue proteome for the first time.
- ◆ **Sugarcane wilt:** About 263 isolates of *Fusarium* were isolated from wilted canes and characterized. Gujarat and east coastal region in tropical India and Gangetic plains in subtropical region were identified as wilt endemic. Pressmud based *Trichoderma* formulation was developed for managing wilt and efficacy this formulation against the disease was validated under endemic locations of Gujarat and Andhra Pradesh.
- ◆ **Wilt pathogen identity and variation:** Detailed studies on pathogenic and molecular variation identified *Fusarium sacchari* as the wilt pathogen.
- **Diagnostics:** Gene specific primers were designed for various viral and phytoplasma diseases for PCR based diagnostics. Specific primers were designed and RT-PCR conditions were optimized to detect two or three RNA viruses infecting sugarcane simultaneously as duplex-RT-PCR or multiplex-RT-PCR in the same reaction.
- **Yellow leaf disease (YLD):** Severity of YLD on sugarcane varieties and its impact on cane growth and yield were studied. Its infection on sugarcane showed upto 37.23% reduction in cane weight, 15.25 % in diameter, 5.03% in internodal length and 19.45 % in juice yield in endemic locations.
- **Cause of mosaic in sugarcane:** Established that *Sugarcane mosaic virus* (SCMV) and *Sugarcane streak mosaic virus* (SCSMV) cause mosaic in sugarcane either alone or together in Indian Subcontinent for the first time. Identified SCSMV as a new virus "Susmovirus" in *Potiviridae*.
- Among the exotic clones screened for important pests, 18 and 11 clones have shown resistance to shoot and internode borers respectively, while 10 clones were found tolerant to the white grub.
- A mass multiplication technique for entomopathogenic nematodes *Steinernema glaseri* and *Heterorhabditis indica* using egg yolk soya flour and Wouts media was standardized.
- Established 100% mortality of white grubs by *Steinernema glaseri* (LN1) and *Steinernema* sp. (HIII) at specified inoculum load under pot culture conditions.
- Arbuscular mycorrhizal fungi (AMF) *Glomus fasciculatum* were found to suppress root knot nematode *Meloidogyne incognita* population under pot culture conditions

Major constraints

- The transgenics for red rot resistance, virus resistance and borer resistance are of much scope, but suitable gene/s is not available in public domain.
- Irrigation water availability; Drought and salinity
- Nutrient deficiencies
- Emerging diseases and pests in sugarcane and minor diseases like pokkah boeng and rust becoming major diseases
- YLD combined with varietal degeneration may become a major issue in different states in the coming years

- Gained virulence of smut, red rot and wilt need to be studied in sugarcane in relation to host resistance and climate change.

Suggestions for improvement

- Validated genes from foreign sources may be obtained for use in developing transgenics.
- Identifying red rot, smut and YLD resistance in sugarcane varieties, parental lines, inbred populations and germplasm and identifying field tolerance mechanism in sugarcane to red rot.
- Survey, surveillance, monitoring and forecasting of sugarcane diseases and pests creating respective maps in the region.
- Identification of novel chemicals/molecules and endophytes for disease management and devising appropriate delivery systems.
- Genomic and proteomic approaches to identify red rot resistance mechanism in sugarcane and establishing pathogenicity determinants of red rot pathogen through functional genomics / knock-out approach.
- Management of non-fungal diseases through production of disease-free planting materials utilizing molecular diagnostics.
- Identification of RNA silencing mechanism in sugarcane against viruses, characterizing virus suppressor proteins and RNAi approach to develop fungal resistance in sugarcane.
- Studies on influence of changes in climatic factors on disease development in sugarcane, pathogen virulence and establishing break-down of resistance in sugarcane to red rot.
- Utilization of bacterial symbionts and entomopathogenic nematodes as pest control agents.
- Development of need based integrated pest management modules

ALL INDIA COORDINATED SMALL MILLETS IMPROVEMENT PROJECT, BENGALURU

Achievements for the period 2010 & 2011

- Maintained 14993 germplasm accessions (7070 finger millet, 2421 foxtail millet, 1491 kodo millet, 1889 barnyard millet, 926 proso millet and 1196 little millet) at NAGS, Bangalore.
- Collection (26 finger millet, 46 little millet), characterization and evaluation (85 finger millet, 95 barnyard millet), rejuvenation (4632) and supply (862) of various small millets were carried out.
- Finger millet varieties, GPU 67, GPU 66 and KMR 301 were released during 2010-11 and the varieties identified for release are:
 - Finger millet VR 929, OEB 526, VL 347
 - Kodo millet DPS 9-1
 - Proso millet TNAU 202
 - Foxtail millet SiA 3085
- Breeder seed (47.75 q of finger millet (13 varieties), 6 q of kodo millet, 2.5 q of little millet and 1.5 q. of foxtail millet) was produced.
- Validation of best identified intercropping system on farmer's field indicated that at Bangalore, transplanting 40 - 45 days old pigeon pea seedlings as intercrop in drilled finger millet (2:8) enhanced productivity of pigeon pea by 324 % (568 kg/ha) and finger millet grain equivalent yield by 56 % (3934 kg FMGEY/ha) as compared to SAU recommendation of finger millet + pigeon pea (2520 kg/ha).

- Participatory testing of improved intercropping system of finger millet + pigeon pea in 8:1 row proportion was the remunerative option to enhance productivity of the intercropping system (38 % in Tamil Nadu) over farmer's practice.
- Maintaining moisture regimes at 75% field capacity at all critical stages of the crop gave higher grain yield in finger millet. Critical period for moisture supply was identified to be the ear emergence stage and stress during ear emergence reduces yield drastically (23%). In areas of water scarcity scheduling irrigation during ear-emergence helps in maintaining higher productivity (Mandya, Karnataka).
- In central Karnataka, improved intercropping demonstrations conducted in finger millet with pigeon pea (8:2) / field bean / castor (8:1) enhanced productivity of finger millet grain equivalent yield by 30 % over farmer's practice.
- At Coimbatore, high yielding varieties with improved management practices enhanced productivity of finger millet (29%), kodo millet (32%) and little millet (63%) over farmer's practice.
- In Central and northern Karnataka, improved finger millet / foxtail millet / little millet varieties with recommended management practices gave higher grain yield (42.82 and 64 %, respectively) over farmer's practice.
- Finger millet blast remains a major production constraint. Recently released varieties GPU 66 for Karnataka and GPU 67 for all India cultivation with moderate blast resistance are being popularized
- Finger millet varieties resistant to head blast often suffer from leaf blast leading to severe loss of photosynthetic area and loss of transplantable seedlings in the nursery. Pre sowing treatment of seeds with Carbendazim @ 2 g/kg seed was found to be a highly remunerative integrated approach for effective control of blast.
- Ragi seed blackening could be minimized by spraying of Chlorothalonil @ 0.2% or Carbendazim @ 0.05% at 50% flowering.
- Finger millet lines viz., GE 4449, VL 149, GE 4440, GPU 28, GPU 48, GE 4867, GE 5187, GE 5192, GPU 45, GPU 26, GE 3090, GE 6870, GE 5237, & GE 4970 with high resistance to blast are identified for utilization in crop improvement programme
- Barnyard millet line PRB 901 has shown resistance to both grain and head smut diseases
- CO-2, OLM 201 and JK 8 varieties of little millet have shown high promise to grain smut and rust diseases
- Blast and rust of foxtail millet assume serious proportions under congenial weather conditions for which entries TNAU 261 and 264 were promising over released varieties PS 4 and SiA 326
- *Sarocladium* sheath rot could be reduced by pre-sowing seed treatment with *P. flourescens* @ 10 g or Validamycin @ 2 ml or Hexaconazole @ 2 ml per kg seed.
- Little millet shootfly could be effectively managed by treating the seeds with imidachloroprid at 0.3 ml per liter of water.
- Under optimal conditions, MR-6 (13.1 g) and GE-1034 (10.5 g) are high root biomass types compared to the ruling variety GPU-28 (6.89 g/ plant) under optimum conditions.
- Accession, GE-4683 is a high biomass and grain yield type under stress compared to GPU-28 and PR-202, and may be utilized in crop improvement programme.
- Yield improvement in finger millet over the years (1939 to 2009) was 47 kg/ha/year. Further improvement is possible to extent of 15-20 % by incorporating high biomass from L-5, GE-4683 into GPU-67, a good plant type with high harvest index suitable for mechanical harvesting with non-lodging character.

- The higher growth rate (> 2.0 g of biomass/day, in case of Indaf-9) may be utilized to improve biomass accumulation in low biomass types like GPU-67.
- Distinct genotypic differences exists for drought tolerance in foxtail millet in terms of leaf rolling (no leaf rolling: ISe 398 and high leaf rolling (> 5 scale): ISe 931), and stay green types (GS 344).
- Steam processing of foxtail and proso millet will maintain lower free fatty acid content and extend shelf life upto 6 months against to only one month in unprocessed foxtail and proso rice.
- Bioavailability of calcium in finger millet was enhanced by malting (75%) compared against to native finger millet (44%). The iron bioavailability in native millet was 10% and it was 19% in malting with not much difference for Zn bioavailability.
- Processing (soaking, roasting and drying) of little millet enhanced the polyphenols, tannin, flavonoid content and free radical scavenging activity.
- Finger millet has higher dietary fibre (12.9 %) compared to other millets
- Carotenoid content was high in foxtail millet (622 mg/ 100g) and proso millet (541 mg/100g) compared to finger millet (94 mg/ 100g) and kodo millet (47 mg/ 100g).
- The nutraceutical properties viz., tannin, polyphenol and free radical scavenging activity was high in brown ragi (474, 231 and 123 %) compared to white ragi.
- Variety GPU-66 has highest tannin (2.38 mg catechin/100g) and polyphenol content (856 mg ferulic acid/100g), while KMR-204 has the highest free radical scavenging activity (168 mg catechin/100g).

ALL INDIA NETWORK PROJECT ON AGRICULTURAL ACAROLOGY

KARNATAKA - UAS Centre, Bangalore and Network unit, Bangalore

- Crop loss due to rice sheath mite, *Steneotarsonemus spinki* in Mandya region of Karnataka ranged from 7.1 (MTU 1001) to 9.5 %.
- Aerobically cultivated rice had higher infestation (50%) of sheath mite *S. spinki* compared to conventional puddle system (33%).
- Fenpyroximate (30 g ai/ha) or fenazaquin (125 g ai/ha) application brought down sheath mite population by 90 - 95% compared to 75 - 85% reduction observed with propargite and chlorfenapyr. These treatments recorded lesser proportion of chaffy grains (3.43 - 4.22%) and discoloured grains (1.16 - 1.36%) and with good proportion of healthy grains (94.3 - 95.4%) compared to untreated plots.
- In Bangalore Rural district, sweet orange suffered heavily due to rust mite *Phyllocoptruta oleivora* during summer months (Feb. – March), which significantly reduced the fruit yield and adversely affected desirable fruit traits like fruit size/weight, juice content, titrable acidity etc.
- Application of 0.005% fenpyroximate resulted in significant reduction in citrus rust mite population as well as damage (97%) in sweet orange and was on par with 0.001% abamectin and 0.057% propargite.
- Chilli entries, Aparna, S 49 and BVC 47 recorded less than 10 yellow mites per five leaves compared to the maximum of 87.2 mites on susceptible variety, Byadgi Kaddi.
- Predatory phytoseiid mite, *Neoseiulus longispinosus* released on spider mite infested polyhouse betel vine at 1:50 or 1:100 (predator : prey) ratio eliminated spider mites completely in 4 weeks period, while ratios, 1:200 & 1: 400 required 6 to 7 weeks.

Tamil Nadu - TNAU, Coimbatore

- Crop loss due to two spotted spider mite in okra crop was up to 65%.
- Rice leaf mite, *Oligonychus oryzae* incidence in Coimbatore was reduced by 70 – 78% following the application of fenazaquin or fenpyroximate or spiromesifen.
- Higher incidence of yellow mite, *Polyphagotarsonemus latus* on Bt cotton was observed in Coimbatore in the early crop growth period.
- Chilli accessions, ACC 06-2, ICE 1 and ICA 288 recorded fewer number of yellow mites (<3 mites/leaf) compared to CA 69 and Kasturi Anmol (8– 10 mites/leaf).
- Okra variety Kasturi bhendi was found tolerant to *T. urticae* compared to Mahyco hybrid. This tolerance was attributed to higher density of trichomes, high levels of phenols, tannins, peroxidases, polyphenol oxidases, phenylalanine lyase and low levels of reducing sugars.
- Coccinellid insect predator, *Stethorus* was observed feeding voraciously on *T. urticae* (on okra), *Oligonychus oryzae* (on rice) and *Oligonychus indicus* (on sorghum) in Coimbatore region.

Kerala - KAU centre, Thrissur

- In Kerala, severity of mite pests especially during summer months (February-March) on vegetable crops like amaranthus, ash gourd, cowpea & tapioca; ornamentals like coleus, duranta & orchids and flower crops like Chinese balsam was observed.
- Jyothi variety of rice was severely damaged by leaf mite, *Oligonychus oryzae* in Palakkad district during June – July due to dry spell during this period.

CENTRAL TOBACCO RESEARCH INSTITUTE RESEARCH STATION, HUNSUR

Important achievements

- Agronomic input package for the promising wilt resistant lines FCH 221 & FCH 222 was developed. The spacing of 100 x 55 cm with a population of 55,000 plants/ha was found optimum for both the lines. However topping at 20 leaves stage was found more advantageous than topping at 22 leaves in line FCH 222.
- Organic production of tobacco revealed that harmful smoke constituents like tar, carbon monoxide, TSNA, TPM etc., could be markedly reduced by organic package involving in-situ green manuring, FYM / vermicompost application, tray nursery seedlings, use of biofertilizers, employing bio-pesticides and bio agents for pest management.
- The Integrated farming system model developed in 0.4 ha for the rainfed ecosystem of Southern Transitional Zone of Karnataka was demonstrated to the farmers.
- The productivity of cured leaf could be significantly increased by the application of higher amounts of potassium (180 kg/ha) in the root knot sick affected soils in KLS.
- *Fusarium* wilt disease resistant lines FCH 221 & FCH 222 derived from FCH 201 and resistant donor Speight G.33 were found promising in on-farm trials with a production potential of more than 2000 kg/ha with desired cured leaf qualities.
- Wilt resistant line FCH 222 which showed higher productivity and high degree of tolerance to *fusarium* wilt disease under field conditions was proposed for release for the *fusarium* wilt endemic areas of Karnataka Light Soils.
- The male fertile hybrid line KLSH-10 recorded 2561 kg/ha cured leaf yield

- Copper hydroxide 77% was found effective for overall management of fungal diseases in the nursery which includes damping off, Blight & black shank, *Anthracnose* leaf & stem infection and frog eye.
- Combined application of *Paecilomyce lilacinus* and *Trichoderma viride* was found to be promising against root-knot nematode and fusarium wilt disease complex in FCV tobacco.
- Nematode egg parasitic fungi, *Paecilomyce lilacinus* enriched vermicompost @ 2 kg/sq. m. nursery caused 45.7 % reduction in root-knot nematode incidence and 51.8 % increase in healthy FCV tobacco seedling count.
- Application of *Pochonia chlamydosporia* 108 spores @100 g/m² in solarized soil caused 60.2% increase in healthy transplants count and Propiconazole 25% E.C. was identified as the best chemical control measure for Sorshein – an emerging disease in the FCV tobacco nursery.
- Bajra as a border/barrier crop with one spray of *Verticellium lecanii* @ 0.3% at 45 DAT proved as an effective integrated approach for the control of tobacco aphid, *Myzus nicotianae* in FCV tobacco field crop.
- Two bio-agents tested SI NPV and *Bacillus thuringiensis* var. Kurstaki proved effective (with 72 and 71.6 % reduction) against tobacco caterpillar in FCV tobacco nurseries.
- Survey studies in KLS region revealed that four insect pests namely Aphid, Bud worm, Stem borer and tobacco caterpillar were presence with 1.4, 3.4, 1.5 and 8.6 % infestation respectively but were below ET levels.
- The survey work on insect pest incidence in tobacco based cropping sequence (rabi crop) of KLS revealed that pod borer, *Helicoverpa armigera* population was highest in field bean (15% pod damage) followed by other pulses like red gram, cowpea and horse gram (10-12%).

IARI, REGIONAL STATION, WELLINGTON

Crop improvement

- Two promising wheat varieties HW 5216 and HW 5224 were promoted to AVT in Southern hill zone and eight (HW 1111, HW 2072, HW 2073, HW 2068, HW 4206, HW 5223, HW 5232 and HW 5234) bread wheat varieties have been promoted to IVT/NIVT-3, which carry different specific rust resistance genes. The varieties HW 5224 and HW 1098 (Dic) are most promising in IVT. Two promising wheat entries HW 4215 and HW 4015 were also promoted to CVT in Southern hill zone.
- The *Secale cereale* derived leaf rust resistance gene Lr45 had been introgressed in to 30 popular Indian bread wheat varieties. In the lines carrying Lr45 the *Thinopyrum ponticum*-derived genes Lr19+Sr25, *Secale cereale*-derived genes Sr31+Lr26+Yr9 and Pm8, moro-derived Yr10 has been pyramided.
- Individual single plants carrying new and effective race specific leaf rust genes Lr35+Sr39 (*Ae. Speltoides*), Lr39, Lr42 (*Ae. squarrosa*), Lr44 (*T. spelta*) and Lr 4 7 (*Ae. Speltoides*) were picked at BC3F2 stage and advanced to F3 during Rabi-2010
- Twenty five advance lines which carry rust resistance genes coupled with high yield are currently evaluated for their yield performance at various locations under shuttle breeding programme and sent for PDSN screening.
- Wheat variety developed for central India applying marker assisted selection (MAS): A bread wheat variety HW 5207-1 has been developed using MAS at this station carrying a high degree of stem and leaf rust resistance.

- Maintenance and utilization of wild wheats: Nearly 3000 accessions of wild species received during 2003 from USDA - small grain were successfully maintained. Characterization of 1300 accessions is over.
- Breeder seed and quality seed production: Four tonnes of breeder seed of HD 2833, HW 3094, & HW 5207 and 10 quintals of pipeline wheat variety HW 5207-1 were produced.
- 10 t of breeder seed of wheat varieties viz. HW 2004, HW 1085, HW 2044, HW 2045, CoW(W)-1, HW 2833, MACS 6145, HW 5207 and HW 1095 as well as pipeline varieties HW 5206, HW 5216, HW 5224, HW 5207-1 and HW 1098 were produced.
- 2.1 t seed was sold to conduct FLDs and 2.0 t for seed production by state seed corporations.
- Promising varieties from Wellington station include HW 5224 in AVT for medium fertility, timely sown and limited irrigated conditions. The promising entry for medium fertility, timely sown and limited irrigated conditions in IVT was HW 5223.
- Transfer of the effective stem rust genes Sr25, Sr26, Sr27, Sr36+pm6, Sr39, Sr40, Sr41, Sr44 either singly or in combination with Sr24 or Sr2 into popular Indian wheat cultivars is undertaken to combat threat from the stem rust pathotype Ug99 virulent on Sr31 and stripe rust genes (Yr10, Yr15, Yr16).
- Newly acquired resistance sources carrying Lr52, Lr53, Lr57 and Lr 67 (APR) which confer resistance against all three rusts have been used for introgression into several adapted Indian cultivars. F1 crosses for Lr53 and Lr57 already planted for further backcrossing.
- More than 135 lines carrying Lr9, Lr19+Sr25, Lr24+Sr24, Lr28, Lr32, Lr37+Sr38+Yr17, Sr26+Sr24, Sr27+Sr24, Sr24+Sr36 etc. at F8., already shared with 22 lead centres involved in wheat breeding in India including DWR, Karnal.
- Development of molecular marker for *Lr 32* gene: Even though many leaf rust resistance genes have been reported worldwide, molecular markers linked to these genes have been discovered for only few of them. In this context, *Lr32* gene, which is not yet explored in agricultural application, is considered for molecular marker development because of its effective resistance against leaf rust. Two markers AP-PCR SS9L₇₀₀ and ISSR marker UBC801₈₀₀ have been found to be associated with *Lr32* gene since they were polymorphic to the gene.

Crop Protection

- Virulence typing of rust pathogens in south India: 276 samples of wheat brown rust and 106 of wheat black rust were analysed for identification of pathotypes prevailing in Wellington area of Nilgiri hills in Tamil Nadu. Brown rust race 77-5 (121R63-1) was found to be the most dominant followed by 77A (109R31), 77-8 (253R31), 17(61R24) and 77-7 (121R127).
- New pathotypes of wheat brown rust (*Puccinia triticina*) noticed at Wellington: Two new pathotypes of wheat brown rust pathogen have been detected in few of the field samples collected from Wellington area of Nilgiri hills.
- Seedling and adult plant resistance characterized in popular wheat varieties of south, peninsular and central India. Adult plant resistance to black and brown pathogens were characterised in advanced progenies of back-cross derivatives of 20 popular cultivars carrying brown rust resistance genes

INDIAN GRASSLAND AND FODDER RESEARCH INSTITUTE, RESEARCH CENTRE, DHARWAD

Research Achievements

Crop Improvement

- In multi-location trials, based on the green fodder yield (GFY) for four cuts, *Brachiaria* lines from IGFR SRRS, Dharwad (DB-1 and DB-4) recorded the highest GFY (227.26 q/ha and 227.23 q/ha). These entries recorded 22 % increase in GFY over the check, *B. decumbens*.
- *Stylosanthes* entry DSS-3 recorded the highest green fodder yield (210.24 q/ha) over two cuts in the multi-location trials followed by DSS-7 (207.88 q/ha).
- The green fodder yield of *Panicum* germplasm lines ranged from 2.3 - 342.6 q/ha and dry matter yield ranged from 0.04–122.3 q/ha at 45 days harvest.
- Putative hybrid seeds were obtained for the first time in *M. sativa* x *M. scutellata* crosses for biotic stress resistance in lucerne.

Crop Production

- Forage based farming systems and horti-pasture systems were established at Tegur farm of IGFR, Dharwad.

Seed Production

- Spraying of micronutrients (boron and potassium nitrate) increased the seed setting and seed yield as compared to control.
- The seeds of range grasses and legumes exhibited severe dormancy immediately after harvest even upto 6 months of storage. Pretreatment of seeds with hot water, manual scarification and acid scarification has enhanced their germination percentage compared to control.

Seed / planting material production details

(kg / number)

Sl. No	Crop	2010-11	2011-12
Seeds			
1	<i>S. hamata</i> (var. Verano)	1100.7	1618.05
2	Lucerne (var. RL-88)	109.65	103.8
3	<i>Desmanthus virgatus</i>	3.1	3.7
4	Perennial sorghum (COFS-29)	414.8	651.05
5	Guinea grass	335.76	61.8
6	<i>Sesbania</i> spp.	9.6	1.05
7	Cowpea (var. EC 4216)	456.1	51.5
8	Maize (ATL)	136.5	0
9	Rhodes grass	0.25	18.75
10	Other spp.	0.7	2.15
	Total	2567.16	2511.85

Planting material			
1	Bajra Hybrid Napier (var. DHN-6)	112328	167615
2	Guinea grass	57500	159705
3	<i>Brachiaria</i> spp.	38950	61500
4	Penisetum trispecific hybrid (PTH)	0	100
5	Rhodes grass	2200	22100
6	Sorghum (COFS-29)	0	9890
	Total	210978	420910

Crop Protection

- Among 27 annual exotic *Medicago* accessions screened for resistance to aphids (*Acyrtosiphon pisum*), four genotypes (EC 541685, EC 541686, EC 547739 and EC 547741) were found to be highly resistant.

Agricultural Extension

- Preliminary analysis of data collected from three ecosystems of south India, covering five states was completed. Contribution of livestock to the total annual income of the household was 23% in semi-arid ecosystem, 30% in humid per humid coastal ecosystem and only 12% in arid eco system.

NATIONAL BUREAU OF PLANT GENETIC RESOURCES REGIONAL STATION, THRISSUR

Salient achievements during 2010 - 2011

- Eight explorations were carried out in Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu, Mizoram, Tripura, Assam and Union Territory of Lakshadweep. This resulted in the collection of 8 accessions from Tamil Nadu, 57 from Kerala, 47 from Karnataka, 63 from Goa, 18 from Maharashtra, 142 from Mizoram, 94 from Tripura, 73 from Assam and 42 from Lakshadweep Islands. Among the collected germplasm, variability was collected in okra (9) and *Abelmoschus manihot* subsp. *tetraphyllus* (10) from Karnataka and red gram (8), *Cajanus lineatus* (9) and rice (9) from Kerala. Out of the collected germplasm, 78 samples were sent for long-term storage in the National Genebank, NBPGR, New Delhi.
- During *rabi* 2009 - 10, 100 accessions of rice and 255 of horse gram were evaluated. During *kharif* 2010, 11 accessions of upland landraces and 59 of lowland rice, 100 of okra and 46 of Malabar tamarind (*Garcinia cambogia*) were characterised / evaluated. During *rabi* 2010-11, 170 accessions of rice, 3 of wild bitter gourd (*Momordica charantia* var. *muricata*), 22 of pumpkin (*Cucurbita moschata*), 5 of cushaw (*C. argyrosperma*), 5 of *Solanum insanum*, 17 of *Kaempferia galanga* and 380 of horse gram were evaluated. During *kharif* 2011, 34 accessions of upland landraces and 85 of lowland rice, 43 of *Sesamum* species and 36 of Malabar tamarind were characterised / evaluated.
- Seeds of 175 multiplied accessions including 100 of rice, 67 forage crops and pumpkin were sent for long-term storage at National Genebank, NBPGR, New Delhi.
- 14 multiplied accessions of recalcitrant seed bearing germplasm such as *Alpinia galanga* (7), black pepper (3) and 1 each of *Myxopyrum smilacifolium*, *Phyllanthus emblica*, *Pourteria campechiana* and *Vitex altissima* were sent for cryo-preservation.
- Transferred 44 accessions of mango to CISH, Lucknow; 1 of gooseberry to CIAH, Bikaner; 156 cassava, 115 taro, 3 lesser yam and 34 wild *Amorphophallus* spp., 7 lesser yam, 35 greater yam and 36 in 11 species of wild *Dioscorea* to CTCRI, Thiruvananthapuram; and

156 accessions of ginger, 241 of turmeric, 100 of wild *Curcuma* spp. and 20 of wild *Zingiber* spp. to IISR, Kozhikode for field genebank maintenance as National Active Germplasm Sites (NAGS) and utilization in crop improvement.

- 55 accessions (cassava-5, ginger-8, lesser galangal-1, greater galangal-6 and brahmi-22) and 10 wild related species (*Dioscorea pubera*-1, *D. pentaphylla*-3, *D. intermedia*-1, *D. belophylla*-1, *D. bulbifera*-2, *D. tomentosa*-1, *D. wallichii* -1, *D. oppositifolia*-1, *Curcuma raktakanta*-1 and *C. aeruginosa*-1) were maintained in *in vitro* conservation media.
- 100 accessions of horse gram were sent to Regional Agricultural Research Station (KAU), Pattambi and UAS, Bangalore for multi-location evaluation under the National Network Project on Arid Legumes.
- One accession of black pepper (IC266417) was registered with No. INGR10065 for its oval shaped berries.

IARI RICE BREEDING AND GENETICS RESEARCH CENTRE, ADUTHURAI

Status of Research

- Induction of two basmati lines for Initial Varietal Trial in All India Co-ordinated trials 2010
- Eight advanced breeding lines are in the final stages of evaluation to be entered into coordinated trials in 2011
- Marker assisted introgression of blast resistance genes *Piz5* and *pi54* and bacterial leaf blight (BB) resistant genes *Xa13* and *Xa21* into parents of Pusa RH10 viz., Pusa 6A, Pusa 6B and PRR78
- Pyramiding of genes for resistance to BB (*Xa13* and *xa21*), blast (*Piz5* and *Pi54*) and brown plant hopper (BPH; *Bph3*, *Bph17*, *Bph18*, *Bph20* and *Bph21*) into Basmati rice varieties Pusa Basmati 1121 and Pusa Basmati 6 is under way
- A major QTL for salt tolerance (*Saltol*) is being transferred to Pusa Basmati 1121

CHAPTER V

PROGRESS OF RESEARCH IN HORTICULTURE

TAMIL NADU AGRICULTURAL UNIVERSITY, COIMBATORE

New varieties released

- 1 **TNAU Vegetable Cowpea PKM 1:** High green pod yield; Very long pods 40 - 45 cm with cluster bearing (3 – 4 / cluster); Semi trailing and highly branched; Seeds mottled with brown and grey colour; First harvest at 45-50 days; Fibre content - 0.89 g and crude protein content – 21.88 (mg /100 g).

Duration 90 – 100 days
Season June - July and January – February
Green pod yield 25 t/ha
- 2 **TNAU Coconut ALR 2:** Nut bearing in 5½ years; Regular bearing; Weight of copra - 135 g/nut; 2.57 tonnes of copra per ha; Oil content - 64.7 %; Possesses drought tolerance; Moderately resistant to rhinoceros beetle, red palm weevil and leaf blight .

Yield 109 nuts/palm /year
Area of adoption: All coconut growing areas of Tamil Nadu especially drought prone areas
- 3 **TNAU Brinjal VRM 1:** High yielding; Spines on leaf, stem and calyx; Cluster bearing; Fruits oval in shape, glossy pink in colour with green tinge in the distal end; Resistant to leaf spot, veriticism wilt and epilachna beetle.

Duration 140 - 150 days
Season June-July, Sept.-Oct., Mach-April
Yield 40 – 45 t/ ha
Area of adoption: Vellore and Tiruvannamalai districts
4. **TNAU Tomato Hybrid CO 3:** Plants semi determinate and suitable for high density planting; Fruits round, medium sized and borne in clusters of 3-5; Good fruit quality with TSS of 5.58⁰ brix, titrable acidity of 0.73% and ascorbic acid content of 35.72 mg/100g; Moderately resistant to leaf curl virus disease and root knot nematode.

Duration 145 - 150 days
Season Feb. – Mar., May-June and Nov. – Dec
Yield 96.2 t/ha
Area of adoption: Coimbatore, Salem, Cuddalore, Thanjavur, Madurai, Theni, Kancheepuram, Trichy, Thoothukudi, Dindigul, Dharmapuri, Krishnagiri, Vellore and Thiruvannamalai districts
5. **TNAU Chilli Hybrid CO 1:** Plants semi tall, spreading and highly branched; Unripe fruits light green in colour, elongated, tapering towards the tip and 10.5 – 12.0 cm long; Capsaicin and oleoresin contents of 0.58 % and 14.0 % respectively; Ascorbic acid 120 mg/100 g fruit; Moderately resistant to fruit rot disease

Duration 195-205 days
Season June - July, Sept. - Oct. and Jan. – Feb.
Yield Green fruit yield - 28.10 t/ha (Dry fruit yield - 6.74 t/ha)
Area of adoption: Thiruvannamalai, Salem, Kancheepuram, Dharmapuri, Krishnagiri, Coimbatore, Madurai, Thoothukudi, Thanjavur, Trichy, and Theni districts

6. **TNAU Celery OTY 1:** Grows 900m above MSL; The seed oil content is 1.71 %; Resistant to white flies, aphids and root knot nematode (*Meloidogyne incognita*) and leaf blight
- Duration 115 days
 Season April - June, August – October and February
 Yield Greens - 30.5 t/ha; Seed - 1.40 t/ha
 Area of adoption: Nilgiris
- 7 **TNAU Casuarina MTP 2:** High yield; Short rotation – 36 Months; Multipurpose – Pulp, pole and Energy
- Duration 3 years
 Yield 125 to 150 tonnes/ha
 Area of adoption: Throughout Tamil Nadu except hilly region

Management Technologies

- **High density planting system in cashew:** Cashew graft planting at 5 x 4 m so as to accommodate 500 in place of normal planting of 200 plants / ha with 7 x 7m. High yield - 3250 kg nuts/ha. Benefit cost ratio – 3.35:1 as against conventional method of 1.50:1. Net Return of Rs. 68,876 every year from 6th year onwards

UNIVERSITY OF AGRICULTURAL SCIENCES BANGALORE

- **Vegetable Cowpea: PKB-4** is a variety with high protein, β carotene content and rich in vitamin C. It is a high yielding variety with fresh green pod yield of 11 t/ha and matures in 80-85 days. It is recommended for cultivation in early Kharif in Zone 5.

UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

- Two tomato varieties (DMT-1, DMT-5) were accepted for release during 2011.
- Post harvest studies and value addition in amla fruits.
- Performance of gerbera and rose varieties under polyhouse.

UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT

Research Highlights

- The coconut based farming system with medicinal plants like Kalmegh, Tulsi & lemon grass as intercrops in coconut have been standardised and found to be highly economical than sole coconut.
- A new cashew variety NDR-2-1 with higher shelling percentage (32%), high kernel count (210/kg) and high seed yield (21 kg/plant) has been identified.
- Soil salt tolerance levels have been identified for winter vegetables like knolkhol (6 to 8 ds/m), cabbage (2 to 6 ds/m), cauliflower (6 to 8 ds/m), onion (4 to 6 ds/m), carrot (4 to 6 ds/m) and sweet potato (4 to 6 ds/m).
- Sapota leaf spot disease management has been standardised. Two sprays of carbendazim @ 0.1% was effective
- Management of koleroga and damping off of arecanut has been standardised : Spraying with 2 g Metalaxyl MZ-72 to the affected and surrounded trees followed by 1% Bordeaux mixture, after 10-15 days of first spray

- Cultivation practices for flower crops like Bird of Paradise and Heliconia and medicinal crop Ashwagandha have been standardised for the northern Karnataka
- Integrated Nutrient Management for sapota has been standardised for higher yield [10 kg Vermicompost + 400:80:300 g of NPK was found good]
- The *in-situ* soft wood grafting technique in Jamun has been standardised with over 80% success.
- Spacing of 60 cm X 20 cm and 50:50:50 kg/ha of NPK has been found optimum for higher yield in Coleus.
- Galfly resistant *Erythrina subumbrance* has been identified for betel leaf live standard.

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

Crop Improvement

The following varieties were released for cultivation in the state by the State Seed Committee on Crop Standards and Release:

Cashew	: Sree
Chilli	: Samrudhi
Drumstick	: Anupama
Ginger	: Athira and Karthika.

The following improved varieties were recommended for release by KAU Variety Release Committee:

Pepper	: Panniyur-8
Snakegourd	: Harithasree
Chilli	: Vellayani Thejus
Fodder cowpea	: Aiswarya
Rice bean	: Surabhi

- Identified two promising coconut selections viz. Keradhara and Kerasulabha for higher nut yield and copra content and one coconut selection viz. Keramadhura for tender coconut. The above cultivars are in the advance stage of release.
- Identified two improved Asoka selections viz. Aswani-1 and Aswani-2 for higher bark yield and high tannin content
- Identified a short statured cultivar “Annur coconut” for the development of a short statured coconut hybrid.
- Identified varieties/hybrids like NS-183, NS-180 & NS-43 in cabbage and cauliflower varieties / hybrids NS-60, Basant & Pusa Magna suited to tropical conditions of Kerala during winter season.
- The hybrid variety Yangambi Km 5 (AAA) with very high resistance to sigatoka leaf spot disease and Big Ebanga were recommended for cultivation in Kerala
- Standardized protocol for *in vitro* multiplication of banana varieties Manjeri Nendran and Big Ebanga
- Protocol for seed set and development was standardized for ginger, turmeric and kacholam.
- Performance evaluation of 40 monopodial orchids belonging to monogeneric, bigeneric and trigeneric origin was done.

- Two cultures viz. MMK and MMV of milky mushroom (*Calocybe indica*) are in the advance stage of release
- Identified twenty two aquatic plants suitable for water gardening.

Crop Production

- Application of enriched vermi compost with *Trichoderma* is found to be effective with respect to yield, shelf life and organoleptic qualities in amaranthus
- Standardized production technology for cultivation of cool season vegetables like cabbage and cauliflower in plains of Kerala
- Developed an ideal model of rain shelter suitable for cultivation of vegetables and a model of ventilated poly house suitable for seedling production and cultivation of high value crops in Kerala
- Use of biofertilizers (AMF / *Pseudomonas* or AMF + *Pseudomonas*) can reduce chemical fertilizers by 25% in coleus.
- NPK@ 75:50:100 kg/ha is found ideal for cassava variety "Vellayani Hraswa", for higher yield in reclaimed alluvial soils of Kuttanad.
- Planting of three plants in a pit at a spacing of 2 m x 3 m with a fertilizer schedule of 100 % recommended dose of fertilizers (RDF) gave higher yield with higher B : C ratio in banana
- The most sustainable perennial crop based cropping system for Wyanad District is found as arecanut + pepper + banana + coffee including livestock components and apiculture
- Identified turmeric as the most remunerative intercrop in banana.
- In banana, vegetable cropping system under partially shaded condition of homesteads in the midland (laterite) farming situation, cowpea (Bush) was found to be the best inter crop with vermicompost as the source of nitrogen
- Developed a most effective propagation method (modified inarching) in jack with 90 % success
- The treatments Paclobutrazol @ 5.0 g/tree, Paclobutrazol @ 5.0 g/tree + NAA 30ppm, Paclobutrazol @ 5.0 g/tree + KNO₃ (3%) were found to be beneficial for inducing flowering after 90 days and to improve yield in mango varieties of Alphonso, Prior and Neelum.
- GA 200ppm + BA 100ppm treatment enhanced growth of mangosteen grafts in the main field and application of 'Paclobutrazol 2.0 g a.i./tree improved yield and yield attributes.
- Dry flower production technology in selected tropical flowers and foliage was developed
- Irrigation at IW/CPE ratio of 0.25 and a dose of 100:100:300 kg NPK per ha is found ideal for maximum yield in pepper
- Developed integrated nutrient and pest and disease management technology utilizing FYM (10 kg/vine), Phosphobacteria (50 g/vine), Bordeaux mixture (1%), *Trichoderma* (50 g/vine), *Pseudomonas* (50 g/vine), 50:50:150g NPK/vine, copper oxychloride drench (0.2%) and Quinalphos (0.05%) in pepper.
- Perennial bajra with Napier hybrid is found as the best fodder based cropping system with highest yield and net returns under irrigated condition.
- Cassava based fodder production system involving alley cropping in cassava cv. Vellayani Hraswa, with two rows of palisade grass (*Brachiaria brizantha* cv. mulato) interplanted with one row of fodder cowpea (*Vigna unguiculata* cv.COFC-8) is the most efficient with respect to biological productivity, quality of feed, economic returns and land use efficiency.

- Air layering is found as the best method for true to type propagation in asokam (*Saraca asoca*).
- Developed Good Agricultural Practices (GAP) for *Sida cordifolia*, *Bacopa monnieri* and jeevakom
- Successful organic cultivation packages were evolved for *Rauvolfia serpentina*, *Desmodium velutinum*, *Pseudatheria viscida*, *Nervilia aragona* and *Seidenfia rheedii*.
- Detected antioxidant properties of important medicinal plants and traditional Ayurveda medicines under in vitro assay conditions
- Developed HPLC fingerprint of polyphenols in important medicinal plants, crude drugs and medicines for detecting adulterants in ayurvedic preparations.
- Developed TLC fingerprinting technique for differentiation of asokam (*Saraca asoca*) bark from that of the major adulterant, polyalthia (*Polyalthia longifolia*)
- Developed protocol for the extraction of colour pigments from Marigold and their application in food products.
- Machine extraction and boiling in NaOH (1%) for 30 minutes is found to give maximum fibre recovery percentage in pseudostem of banana varieties Nendran and Mysore Poovan
- Developed probiotically fermented food mixtures from banana (Nendran), defatted soya flour, green gram flour, ripe mango, papaya and tomato.
- Formulated STCR targeted yield equations for pumpkin, banana and coleus

Plant Protection

- The parasitoid *Acerophagus papaya* is found very effective for controlling infestation of mealy bug in papaya
- The population of coconut leaf caterpillar *Opisina arenosella* was significantly reduced after release of the natural enemies *Cardiastethus exiguus* and *Goniozus nephantidis*
- Isolated an entomopathogenic fungus, *Paecilomyces lilacinus* for the first time from the root mealy bug, *Geococcus* sp and was found to be the most promising fungus for the management of melon fly. Its mass multiplication was found to be best in rice bran.
- Developed four consortial formulations of bioagents (*Trichoderma harzianum* + *Bacillus magaterium*, *Trichoderma harzianum* + *T. viride*, *Trichoderma harzianum* + *Pseudomonas fluorescens* and *Bacillus magaterium* + *Pseudomonas fluorescens*) with shelf life of 6-12 months for the management of *Phytophthora* rot of black pepper and vanilla and bacterial wilt of chilli
- Identified promising bacterial endophytes *Pseudomonas putida* (EB-31), *Bacillus subtilis* (EB-35), *P. plecoglossicida* (EB-40) and *P. aeruginosa* (EB-65) based on cultural, morphological and biochemical characters
- Standardized the technology for the cultivation of mushrooms viz. *Pleurotus* spp & *Calocybe indica* on rubber dust.
- Standardized and popularized the value added products viz. mushroom wine (Koonamruthu), dried mushroom powder and mushroom sauce from Oyster mushroom.

NAIP- Agricultural Market Intelligence

- 8 commodity price forecasts for pepper (3), coconut (2), and cardamom (3) and 3 updates for pepper (1) and cardamom (2) were released.
- Developed a Portal and 97 Newspaper releases, 17 TV telecasts and 11 Radio broadcasts for disseminating the price forecasts.

INDIAN INSTITUTE OF HORTICULTURAL RESEARCH, BENGALURU

Significant Achievements

Vegetable Crops

- Released two hybrids in tomato, four varieties and two synthetics in onion, three varieties in Dolichos, one variety in bean and two varieties in Amaranthus.
- Identified a tomato hybrid with multiple disease resistance to TLCV, bacterial wilt, early blight and nematode.
- Identified high yielding varieties tolerant to virus and powdery mildew in chilli, bacterial wilt in brinjal, photo-insensitivity in pole beans and Dolichos. Two tropical cauliflower varieties suitable for summer cultivation, capable of setting seeds under Bangalore conditions have been identified.
- Transferred successfully genes from wild species for higher level of resistance to viruses in tomato.
- Developed stable source of resistance to late blight of tomato.

Fruit Crops

- Released high yielding varieties having novel traits namely 'ArkaPrabhat' in papaya and "ArkaKiran" in guava.
- Morphological characterization of 350 varieties of mango was carried out using Biodiversity International Descriptors.
- Standardized High Density Planting Technique in mango

Ornamental Crops

- Released three varieties in gladiolus, two each in carnation and crossandra and one each in gerbera, rose, chrysanthemum and tuberose.
- Registered four lines each of rose and carnation with NBPGR.
- Production technologies standardized for cultivation of *Dendrobium* species under tropical situation.
- Off-season pruning was standardized in jasmine sambac.

Medicinal Crops

- 186 germplasm of Ashwagandha were collected and characterized.
- Two lines in Mucuna (ArkaAshwini and ArkaDhanvantari) were identified.
- In ten species of Rare, Endangered & Threatened (RET) medicinal plants, collection, conservation and characterization were taken up.

Economics & Statistics

- Evaluation of impact of technologies indicated that use of 'Dogridge' grape root stock brought forth 10% reduction in cultivation expenses, 25% increase in yield, 20% higher price due to improved quality and overall 70% increase in net returns.
- Adoption of foliar nutrition in banana gave a yield advantage of 10% in main as well as ratoon crops and 24% increase in net returns with a BCR of 3.66.
- Seasonal ARIMA model was used to forecast prices in pomegranate and the predicted prices coincide with the actual prices in about 70% of the cases.
- Economics of pest management in Capsicum under protected structure indicated that the average cost of establishment of net house was Rs 164/m² and the cost of plant

protection accounted for 21% of working expenses. Investment feasibility analysis indicated a BCR of 1.55 and an IRR of 70% with a payback period of two years.

- Crop logging models in banana (cv. Ney Poovan) were developed to identify significant yield predicting biometrical traits along with their optimum values across different crop growth stages based on farmer's field data.

Plant Physiology & Biochemistry

- Sensitivity analysis of InfoCrop simulation models for tomato and onion showed the reduction in tomato up to 20% when the temperature increased up to 5°C.
- Yield reduction in onion was up to 40% with increase in temperature of 3°C and 75% reduction with 4°C increase.
- Rootstock showing high salinity tolerance had high soluble protein concentrations, activities of SOD, catalase and peroxidase and greater induction in 11, 42.7, 66.4, 70.1 and 89.4 KDa proteins.
- The antioxidant response in terms of peroxidase, polyphenol oxidase, catalase and superoxide dismutase to low temperature was less in Banganapalli compared to Alphonso.

Seed Science & Technology

- Techniques to improve seed yield and quality have been developed both for varieties and hybrids of vegetable crops.
- Methods to evaluate, maintain and improve seed quality have been developed in some important fruit, vegetable, flower and medicinal crops.

Entomology & Nematology

- Standardized molecular systematics and developed protocols for identification of major sucking pests and their bio-types.
- Community based approaches for management of mango fruit fly and stone weevil using male annihilation techniques, sanitation and bait spray was carried out.
- Surveillance models for mango fruit fly and hopper is under preparation integrating various climatic parameters.

Plant Pathology

- Developed diagnostics for WBN in watermelon, early blight in tomato and anthracnose in chilli.
- Emergence of late blight in tomato was found to be associated with metalaxyl resistance and appearance of a2 mating types and new DNA heplatoids.
- Standardized cultivation practices for shitake mushrooms.

Soil Science & Agricultural Chemistry

- Crop specific micronutrient formulations developed for banana, mango, citrus and vegetables were commercialized.
- Litter nutrient dynamics and nutrient accretion in mango quantified.
- Developed Fertilizer prediction equations for targeted yields based on soil test values.
- Efficient strains of VAM, Azotobacter and PSBs were isolated, and characterized and developed bio-fertilizers.
- Protocols for analysis of new generation pesticides developed.

Agricultural Engineering

- Tractor operated low cost raised bed former-cum-transplanter for chilli and vegetable crops, onion transplanter for flat bed, size grader to grade fruits (thickness in mango and diameter in pomegranate), manually operated pomegranate aril remover and a mechanical Totapuri harvester have been redesigned and fabricated.
- Motorized continuous peeler for raw mango and raw papaya, motorized raw mango slicer and raw mango cutter have been commercialized.

Post-Harvest Technology

- An integrated pre- and post-harvest protocol was standardized in mango.
- Bulk ripening technique for mango, papaya and sapota was standardized using ethylene gas.
- Osmotic dehydration techniques for mango, papaya, pineapple and aonla were standardized.
- Useful products were prepared utilizing of waste products of cauliflower and cabbage. Paper was developed utilizing waste from banana

Plant Genetic Resources

- Through 43 explorations 1235 accessions-of plants, seeds, cuttings were collected and conserved. Established field gene bank of over 100 species.
- *In vitro* conservation protocols have been optimized for 23 species; 85 accessions in the form of seed, live plants, cuttings & *in vitro* plant material have been deposited with NBPGR.
- 600 genotypes of indigenous and exotic accessions of fruits, vegetables and ornamental crops were evaluated for resistance to major insect and mite pests.
- 55 accessions of guava, 25 accessions of sapota and 225 accessions of mango were characterized morphologically.
- Molecular characterization of 25 genotypes of tomato, brinjal, water melon, dolichos, pumpkin, French beans, palak and chillies was carried out.

Biotechnology

- Chitinase gene from *Trichoderma harzianum* was cloned. From tomato seeds n-gene was cloned against tospovirus. AMP gene was cloned from onion seeds against bacterial diseases
- DNA finger printing was carried out for 70 Institute varieties.
- Characterized 269 mango varieties using fourteen micro-satellite markers.
- Transgenic tomato resistant to PBNV has been carried forward to RCGM Trials.

Extension & Training:

- Constraints in the adoption of horticultural technologies were documented, triangulated and prioritized. Feedback was provided to various Divisions and incorporated in the research programmes.
- Commodity groups in vegetables and ornamental crops have been started and are being monitored.
- Innovative extension methodologies like Group Approaches, Farmers' Fields School, Techno-Agents in Horticulture and mobile-telephony were employed for dissemination of technologies.

Varieties / hybrids released

Vegetables

- Tomato: ArkaSamrat, ArkaRakshak
- Chilli ArkaHarita
- Watermelon ArkaAiswarya, ArkaAkash, ArkaMuthu, ArkaMadhura
- French Bean ArkaAnoop, ArkaSharath
- Dolichos ArkaSoumya, ArkaSambhram, ArkaAmogh
- Onion ArkaSwadista, ArkaUjjwal, ArkaVishwas, ArkaSona. ArkaAkshay (Syn-4), ArkaBheem (Syn-6)
- Amaranth ArkaSamraksha. Arka Varna
- Cauliflower ArkaVimal (IIHR-316-1), ArkaSpoorthi (IIHR-371-1)
- Coriander ArkaIsha

Fruit Crops:

- Papaya ArkaPrabhath
- Guava ArkaKiran

ORNAMENTAL CROPS:

- Carnation ArkaTejas
- Gladiolus Arka Amar, Arka Gold, Arka Naveen
- Tuberose ArkaNirantara

Medicinal Crops:

- Mucuna ArkaAswini, ArkaDhanvantri

Technology commercialized

- Okra GMS line
- ArkaMeghana Chilli Hybrid seeds
- Onion Hybrids-ArkaKirthiman and ArkaLalima
- Tomato F1 Hybrids 240 &241
- Brinjal Selection-2
- Arka Citrus Special
- Arka Mango Special
- Arka Vegetable special
- Neem Soap & Pongamia Soap
- Micronutrient Formulations for Banana and Vegetables
- Osmotic Dehydration Technologies and Ready to Serve Beverages
- Pheromone Trap
- Mass Production of *Trichoderma harzianum*, *Verticillium chlamydosporium*, *Paecilomyces lilacinus* *Pseudomonas fluorescens*, *Trichoderma viridae* and *Pochonia chlamydosporia*

NATIONAL RESEARCH CENTRE FOR BANANA, TRICHY

Significant Research Achievements

Crop Improvement

- DNA gene bank with 310 accessions has been established. Protocol has been developed and validated to use seed DNA as a medium term conservation strategy.
- Low cost, farmer friendly mass multiplication technology has been developed.
- Embryo genic cell suspension cultures (ECS) the basis for genetic transformation in banana has been successfully developed. The cells have been regenerated in cvs. Nendran and Rasthali and finetuned for cvs. Grand Naine, Robusta and Ney Poovan.
- Identified an EST-SSR marker (STR8) which showed distinct polymorphism between nematode resistant and susceptible cultivars.
- The accessions, Singhlal, Sakkarachayna, Malai Kali, Manik Champa, Madavazhai, Kartobiumtham and Marabale were found resistant to root-lesion nematode.
- *Musa balbisiana* (BB) Acc. No.167, Erodekai (ABB) Acc. No. 415, Mysore (AAB) Acc. No. 362, Poovan (AAB), Karpuravalli (AAB) Acc. No. 721 and Saba (ABB) were drought tolerant banana genotypes.
- Identified three hybrids viz. Anaikomban x Pisang Jajee, Anaikomban x Cultivar Rose and Anaikomban x Pisang Lilin as resistant to both root-lesion and root-knot nematodes.

Crop Production

- DRIS indices for Nendran banana have been standardized and DRIS chart was developed. Fertilizer adjustment equations for Nendran, Rasthali, Ney Poovan, Poovan, and Karpuravalli have been developed and validated under AICRP (TF) at different locations.
- Slower rate of leaf senescence, increased activity of ant oxidative enzymes, higher epicuticular wax content, Membrane Stability Index and RWC traits have been identified as putative traits for drought tolerance screening in banana in the vegetative stage.
- A recipe was standardized for preparation of banana flower based ready- to- serve soup mix.
- Blending banana juice with pineapple, passion fruit and tomato juices in the ratio of 60: 40 ratio was acceptable.
- On comparative evaluation, both peel and flower pickles (thokku) were accepted as fresh, while central core stem pickle with high fibre content was acceptable after two months of storage/curing.
- 'Sip-up', a banana pulp based product was developed and storage conditions were standardized.

Crop Protection

- Identified semiochemical traps for Banana corm weevil, *Cosmopolites sordidus*.
- For the first time *Fusarium* wilt incidence was observed in cvs. Cavendish and Poovan. The Foc isolates from these varieties have been characterized by VCG and molecular methods.
- Presence of cross reaction among race-1 and race-2 isolates of Foc was observed among 64 Foc isolates collected from Andhra Pradesh, Kerala, Tamil Nadu, Assam and Arunachal Pradesh and the same has been validated under pot culture condition.
- A new corm rot disease caused by *Sclerotium rolfsii* was recorded for the first time and confirmed by DNA sequencing.

- The pathogen causing leaf spot disease in India was identified as *Mycosphaerella eumusae*.
- Diagnostic kits have been developed for all the four banana viruses and are being used for detection on commercial basis. A PCR technique has been developed for simultaneous detection of two (Duplex PCR) and three banana viruses (Multiplex PCR) viz., Banana bunchy top virus, Banana streak virus and Banana bract mosaic.
- RT-PCR has been standardized for all the four banana viruses including DNA viruses. A multiplex RT-PCR to detect BBTV and BSMysV has been developed.
- Primers and probes were designed for BBTV and BSMysV in collaboration with DSMZ, Germany. Using these primers, real time PCR has been standardized for BBTV.
- Virus free nucleus material of Hill banana has been developed and is being multiplied and supplied to growers.

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE, KASARAGOD

Significant research achievements

Crop Improvement

New varieties / hybrids released in coconut

Variety / hybrid	Year of release	Important traits	Recommended for the States
Kalpasree	2012	Superior quality oil; very sweet tender nut water and meat; annual yield of 90 nuts (14.1 kg copra) per palm.	Root (wilt)prevalent tracts of Kerala
Kalpa Sankara	2012	Yields of 84 nuts/palm/year; has tolerance to root (wilt) disease; semi tall in nature; precocious bearing and relatively higher yield in root (wilt) diseased tracts.	Root (wilt) prevalent areas
Kalpa Samrudhi	2012	Yields 117 nuts (25 kg copra) / palm / year; good tender nut water quality and relatively drought tolerant	Kerala and Assam

- CPCRI has the largest assemblage of germplasm with 398 coconut accessions including 266 indigenous and 132 exotic ones; 164 arecanut accessions including 141 indigenous and 23 exotic ones; and 291 exotic cocoa collections.
- For collection of cold tolerant coconut germplasm, targeted exploration was undertaken in Bhagalpur, Katihar and Purnea districts of Bihar. A large-fruited coconut accession was collected from Sindhudurg district of Maharashtra for conservation and evaluation.
- Five new local ecotypes of coconut were located during the year: Jappanam ecotype with large fruits and nuts, thick shell and thick endosperm from Alleppey district of Kerala; Devermute ecotype with oval medium fruit; Mavinkuruva ecotype with angular, round or oblong fruits; Kalache ecotype with large angular fruits and Yana ecotype with large round and oblong fruits from Uttar Kannada district of Karnataka.
- The cocoa collections has been further enhanced with 11 exotic clones (resistant to mirids, thrips and canker) acquired through Reading University, UK and six local collections from Kanyakumari district.
- Preliminary evaluation of coconut accessions for cold tolerance has shown that among the 31 accessions, Mohitnagar-III has recorded early germination, high germination

percent and high seedling vigour during colder months (October to January) under sub Himalayan *terai* region of West Bengal.

- Among the 21 cocoa hybrids grown under arecanut in high densities, the hybrid SCA-6 x ICS-6 recorded >2 kg dry bean yield/tree/year. The hybrids VTLCH-2, VTLCH-3 and VTLC-1 showed high performance and adaptability both under arecanut and coconut shades.
- From the sequences of RGAs already obtained from coconut using the degenerate primer-based cloning strategy, gene-specific primers were designed and used to amplify putative RGAs from root (wilt) resistant and susceptible West Coast Tall and Chowghat Green Dwarf cultivars.
- Three coconut varieties (selections from the accessions IND 045S, IND 048S and IND 058S), two arecanut varieties viz., VTL 62 (Shriwardhan selection) and VTL-7 (Nalbari) and two cocoa selections (VTLC-1 and VTLC-57) were recommended for release.
- Coconut pollen varieties WCT and COD retained its viability and fertility even after a storage period of 4 years in liquid nitrogen.
- Genomes of three plant growth promoting rhizobacterial strains of *Pseudomonas fluorescens* were analyzed for microsatellite tracts.

Crop Production

- In coastal littoral sandy soil, Gajendra variety of elephant foot yam yielded high corm yield (17.6 t/ha) as an intercrop in coconut, when grown with soil moisture conservation measures like the husk and coir pith application.
- Guinea grass (GG Co-3) gave higher green fodder yield under husk application (8.0 - 8.5 t/cutting with a total yield of 82.2 t/ha/year). The impact of fertigation has brought conspicuous results in terms of copra yield in the coastal sandy soil, clearly indicating a 50% saving of chemical fertilizer through drip fertigation.
- Thevam variety of black pepper had recorded significantly higher dry berry yield (1.71 kg/vine) when grown as a mixed crop in coconut garden.
- Recycling of the biomass along with application of organic manures (cow dung, cow urine, biogas slurry) in the cropping system is found to be self-sustainable in terms of nutritional requirement of coconut and other component crops in a mixed farming system for root (wilt) affected coconut gardens.
- A 16S rRNA based analysis of the bacterial diversity in different stages of coconut leaf vermicomposting process has shown that the Bacteroidetes and α -proteobacteria constituted 50% of the major taxonomic groups in the beginning and middle stages of the vermicomposting process.
- *Bacillus cereus* (ESB 15), *Bacillus* sp. (RSB 14) and *Serratia marcescens* (KiSII) isolated from the rhizosphere of coconut and five *Bacillus subtilis* isolates (CSB 8, KGEB 10, PEB 2, PEB4 and VEB 17) from cocoa rhizosphere could tolerate a maximum temperature of 60°C and were also able to grow on TSA medium amended with 12% NaCl.
- Among the four summer vegetables viz., ridge gourd, chilli, okra, amaranthus tried under arecanut in North East condition, okra performed well under fertigation.
- Soil and leaf nutrient status of disorder affected arecanut plantations indicated zinc deficiency in 84 to 97 % of palms in clay and laterite soils.
- Microbes for cellulose degrading were isolated from the gut contents of active adult earthworms degrading the coconut leaves to compost and screened for their cellulose and lignin degrading capabilities.

Crop Protection

- Copper oxychloride 0.5%, phosphorous acid (Akomin 0.5%) and cultural practices (removal of infected pods and proper pruning) are promising in the management of black pod disease.
- In addition to imidacloprid, granules of two green labeled insecticides viz., flubendamide and Chlorantraniliprole were found to be promising against red palm weevil.
- The delivery of aggregation pheromone, ethyl 4 methyl octonate, using mesoporous silica, polystyrene beads and activated charcoal was studied. In the field pheromone loaded in nanoporous delivery matrix trapped 424 beetles in 20 weeks.
- *Phytophthora* sp. causing bud rot of coconut in Wyanad, Udupi and Coimbatore districts was identified as *P. nicotianae*. *Phytophthora* sp. isolated from fruit rot of coconut in Chikkamagalur district was identified as *P. capsici*.
- Placing *Trichoderma* coir pith cake in the innermost leaf axils of coconut palm just before the onset of south-west monsoon (May end) and thereafter at two months interval was found to be effective in the management of bud rot disease of coconut.
- The common slug, *Deroceras* sp. found in coconut and cocoa gardens during rainy season plays a major role in the spread of *Phytophthora* diseases of both the crops.
- Prophylactic management of rhinoceros beetle through leaf axil filling with Chlory dust (Chlorpyrifos 1.5% DP @ 6.0 g + 250 g sand), Ferterra granules (Chlorantraniliprole 0.4% W/W GR @ 6.0 g + 250 g sand) and botanicals (Pongamia cake + 250 g sand) was found to be effective in reducing leaf damage (47-66%) in coconut.
- A significant reduction in mite incidence (70-81%) on fresh bunches could be observed in palms treated with palm oil (200 g)-sulphur (5 g) emulsion.

Physiology, Biochemistry and Post Harvest Technology

- Technologies for preparation of value added products from VCO meal (coconut bar and biscuits) were developed and some of technologies like vinegar from coconut water and coconut water squash were further refined / modified.
- Studies on preservation and processing of coconut sap and haustorium into high-value natural and nutritious food products are underway. Heat pump drying of haustorium slices has resulted in distinctly bright coloured dried product at 60°C for 8 hours.
- Modification and evaluation of the processing gadgets / equipments like manual coconut slicing machine, biofuel dryer and the biofuel virgin coconut oil cooker are underway.
- An agricultural waste fired Virgin Coconut Oil Cooker has been developed to produce virgin coconut oil from coconut milk.
- The time required for producing ball copra could be reduced considerably by giving heat treatment to partially dehusked coconuts in the CPCRI Solar tunnel dryer. The dryer could turn 77% of the coconuts to ball copra by nine months and 94% by the end of the year.
- A safety attachment to the climbing device developed by a farmer, has been designed involving a wire rope and a body harness

Social Sciences

- Under the farmer participatory action research programme (FPARP), technologies for soil and water conservation were demonstrated in farmers' plots in Kasaragod District. Impact analysis revealed the efficacy of soil and water conservation and low cost water harvesting technologies for water saving and enhancing crop yield.
- By 2025, the demand for coconut is estimated at 32,000 million nuts per annum and we may be able to produce 24000 million nuts only. The demand of arecanut for the year

2020 is estimated as 849,000 t against the estimated supply of 816,000 t. The demand of cocoa by 2020 is estimated as 45000 t against the estimated supply of 28000 t.

- Analysis of coconut market structure revealed supply deficit, price rise in substitute oils, surging industrial demand, high volume of exports and a global shortfall in edible oil supply to be the reasons for recent price escalations in coconut and coconut oil.
- Under ideal management conditions, the cost of production of coconut in Kerala under rainfed and irrigated conditions is Rs. 6.00 and Rs. 5.00 per nut respectively. Cost of production of arecanut (chali) in a well-maintained garden was found to be Rs 104.20/kg and that of cocoa is Rs 74.42/kg of dry beans.

Multiplication of planting materials

Good quality planting materials of coconut, arecanut, cocoa were produced and distributed to the farming community and developmental agencies.

Crop	2010-11	2011-12
Coconut	101,977	90,000
Arecanut	242,657	421,244
Cocoa	1,21,642	50,000

Technology ready for transfer

- Package for cultivation of different horticultural crops under coconut and arecanut plantations.
- Diversified coconut products such as virgin coconut oil, coconut chips and snowball tendernut are available technologies for entrepreneurship development.
- Portable snowball tendernut machine, & shell fired copra dryer
- IPM and INM technologies for coconut and arecanut.
- Technology for vermicomposting of coconut palm wastes by using a local earthworm, *Eudrilus* sp., and production of vermicompost from coconut leaves in 75 to 80 days period.

ALL INDIA COORDINATED RESEARCH PROJECT ON PALMS, KASARAGOD

The All India Coordinated Research Project on Palms is coordinating research on coconut, oil palm and palmyrah in 20 centres located in 12 States. In Region VIII, the centres are located in Karnataka, Tamil Nadu and Kerala.

Centres in Region-VIII

State	AICRP on Palms Centre	University	Crop(s)
Karnataka	Horticultural Research Station, Arsikere, Hassan Dt.	UHS, Bagalkot	Coconut
	Agricultural Research Station, Gangavathi, Koppal District.	UHS, Bagalkot	Oil Palm
Tamil Nadu	Coconut Research Station, Aliyarnagar, Coimbatore Dt.	TNAU, Coimbatore	Coconut
	Coconut Research Station, Veppankulam, Thanjavur Dt.	TNAU, Coimbatore	Coconut

State	AICRP on Palms Centre	University	Crop(s)
	TRRI, Aduthurai, Thanjavur District.	TNAU, Coimbatore	Oil palm
	AC & RI, Killikulam Tuticorin District.	TNAU, Coimbatore	Palmyrah
Kerala	RARS, Pilicode Kasaragod District	KAU, Vellanikkara,	Coconut

Salient Achievements

Coconut

Crop Improvement

- ❖ TNAU coconut ALR (CN) 3, a selection from Kenthali dwarf is an exclusive tender nut variety recommended for release in Tamil Nadu by the State Variety Release Committee.
- ❖ A total of 11 ecotypes (CRP735-CRP746) were collected from Tamil Nadu and 13 from Karnataka for further evaluation.
- ❖ At Veppankulam, among the 11 germplasm, CRP 509 (VPM) recorded the highest nut yield/palm (113) during the year 2008-09 followed by IND 040 and IND 018 (91). The annual nut yield/palm during the year 2009-10 was the highest in CRP 509 (MBM) (145) followed by IND 018 (142).
- ❖ At Arsikere, the nut yield (av. 4 years) was higher in the cross combinations of GBGD x LCOT (132) and GBGD x PHOT (131) compared to Kalpatharu (90). Hence, these combinations can be released for cultivation in the *maidan* tract of Karnataka.

Crop production

- ❖ In a 18 year old coconut garden, the aromatic plant lemongrass (*Cymbopogon flexuosus*) recorded leaf yield of 7,170 kg/ha with a net income of Rs. 23,270/ha and B:C ratio 2.17. The medicinal plant Sitharathai (*Alpinia galanga*) recorded 6,020 kg/ha of rhizomes with a net income of Rs.30,250/ha and B:C ratio 2.43 during the second year of the crop at Aliyanagar.
- ❖ At Veppankulam, *Alpinia galangal* recorded an yield of 2740 kg of dry tuber/ha, while Aloe vera recorded 12350 kg of fresh leaf and thulsi (*Ocimum sanctum*) 13400 kg of fresh leaf/ha respectively. *Cymbopogon flexuosus* and *Pogestemon patchouli* recorded 7250 kg and 1210 kg of dry leaf/ha respectively.
- ❖ For maidan tract of Karnataka, intercropping in coconut gardens with lemon grass, garden rue (*Ruta graveolens*), thulsi, Kalmegh (*Andrographis paniculata*), arrow root (*Maranta arundinaceae*), and Makoi (*Solanum nigrum*) was found to be profitable.
- ❖ At Kasaragod, 100% recommended dose of fertilizer through drip fertigation was on par with 50 and 75% of fertilizer application through drip fertigation. The same trend was seen in the Aliyanagar and Arsikere centres also. These results clearly indicate that 50% saving of chemical fertilizer is possible through drip fertigation.

Disease Management

- ❖ Root feeding with carbendazim 2% @ 100 ml/palm at quarterly interval is recommended to manage leaf blight disease in coconut in interior Tamil Nadu.
- ❖ For managing leaf blight of coconut, root feeding of *P. fluorescens* culture filtrate (25 ml) at quarterly interval combined with soil application of *P. fluorescens* talc formulation (50g) + neem cake (5 kg/palm) was found to be the best and significantly reduced the

incidence when compared to the individual application as either root feeding or soil application.

- ❖ For managing *Ganoderma* wilt of coconut in TN, talc formulation of *Trichoderma viride* (50 g) in combination with 5 kg neem cake/palm/year should be applied to all palms in a garden where diseased palms are noticed. Even if one diseased palm is noticed in a garden, the treatment should be imposed to all the palms.

Pest Management (Tamil Nadu)

- ❖ Release of improved strains of larval parasitoids *Bracon brevicornis*, *Goniozus nephantidis*, and pupal parasitoid *Brachymeria nosatoi* at 21 days interval each five times consecutively has shown significant reduction in Black headed caterpillar population.
- ❖ Release of egg/larvae predator, *Cardiostethus exiguus*, in the crown of 10 % of coconut palms in a garden @ 50 bugs / palm for six times at 5 days interval at egg-early larval stages of coconut black headed caterpillar gives effective control of the pest in Tamil Nadu.
- ❖ The population of the Eriophyid mite in two month old buttons of treated palms was reduced after imposing the IPM package.

Oil palm

- ❖ At Gangavathi, the FFB yield differed significantly among the various genotypes. Mean bunch weight was significantly higher in the genotype ZS-3 (42.9 kg/bunch) followed by ZS-1 (33.90 kg/bunch) and ZS-9 (33.10 kg/bunch).
- ❖ Studies at Gangavathi indicated no significant difference in the FFB yield as influenced by different doses of NPK applied through fertigation.

Palmyrah

- ❖ A joint survey was undertaken to explore the collection of palmyrah at Prakasam and Guntur districts of Andhra Pradesh. A total of 15 accessions were assembled and the present germplasm collection at Killikulam centre stands as 238.
- ❖ The trees which were defoliated to the level of 30 % continued to record the maximum number of inflorescences (11) and fruits per tree (100) followed by 50 % defoliation.

INDIAN INSTITUTE OF SPICES RESEARCH, KOZHIKODE

Achievements 2010 and 2011

- Black pepper accession Kumbachola (Acc. No. 1114) which is resistant to Pollu beetle and drought was found to be tolerant to *Phytophthora* infection also. On screening mapping population for *Phytophthora* resistance, through leaf, stem and root inoculation methods,
- A machine capable of mixing, pulverizing, sieving, and filling of potting ingredients in poly bags (1600 bags/day) at desired quantity was fabricated in collaboration with CIAE, Coimbatore centre.
- Cardamom accession IC 547206 and IC 584093 were identified as high yielding with more number of capsules per plant.
- ISSR profile of 100 small cardamom genotypes was developed using 25 ISSR primers. The dendrogram of inter relationships was prepared. Ginger EST SSRs when tested for small cardamom gave a few polymorphic markers.
- Three high yielding genotypes, viz. IC 584097, IC 584098 and IC 54722 have yielded 20 – 40% higher yield than control (Appangala-1 and Njallani Gold).

- A reliable RT-PCR based method was also developed for detection of *Banana bract mosaic virus* (BBrMV), the virus infecting cardamom.
- A new bacterial wilt disease on small cardamom was noticed in Wayanad, Kerala. Phenotypic and genetic characterization revealed that the causative organism is *R. solanacearum* biovar 3 phylotype 1. Timely advisory has been given to developmental agencies to prevent the spread of the disease.
- Among different systems of management, organic and integrated systems recorded comparable yields (30.2 and 30.6 t/ha) of turmeric. The variety Alleppey Supreme has recorded higher yield (17%) under organic system than Prathiba. .
- The effect of Zn and B on the yield and quality of turmeric var. Prathiba was studied. Soil application of Zn @ 5 kg/ha and 0.25% Zn as two foliar sprays along with application of recommended dose of P recorded higher rhizome yield compared to no zinc application. Curcumin content was significantly higher (5.11%) in two foliar sprays of B @ 0.2%.
- Maximum retention of curcumin (5.91%) and essential oil (3.6%) was obtained in turmeric rhizomes cured by traditional boiling method for 40 minutes. Increase in curing time above 60 minutes resulted in significant reduction in curcumin, starch, essential oil and oleoresin contents.
- Turmeric variety IISR Prathibha performed well in farmers' plots at Guntur, Andhra Pradesh and Gundlupet in Karnataka under different systems of planting. The variety showed less incidence of rhizome rot under field conditions and tolerant to water logging compared to the local types (Tekurpet and Salem).
- Suvarana (PCT-8), an improved variety of turmeric released by IISR in 1987, is now occupying about 80% of total area under the crop in Bhavani Taluk. The farmers reported a yield of 35-40 t/ha from the improved varieties in Bhavani Taluk.
- Ginger Acc. 219 was found to be promising with high yield and nematode tolerance.
- Field experiments indicated that *Bacillus amyloliquefaciens* (GRB 35) and *Serratia marcescens* (GRB68) were promising for disease control and plant growth promotion in ginger. The strains GRB 68 (*S. marcescens*) and GRB 35 (*B. amyloliquefaciens*) were found to enhance sprouting of rhizomes besides reducing soft rot and bacterial wilt.
- The Plant Germplasm Registration Committee approved the registration of nutmeg germplasm A9-71 (IC 537220, INGR10142) as a source of high sabinene (45.0% sabinene in nutmeg oil and 41.9% sabinene in mace oil). It has low levels of myristicin (1.9% and 1.1%), elemicin (0.8% and 1%) and saffrole (0.1% and 3.2%).
- Green chip budding with orthotropic buds was successful in nutmeg on *Myristica fragrans* rootstock with 90-100% success. The ideal time for budding was August to November.
- Chemoprofiling of curry leaf essential oil revealed that *t*-caryophyllene which was up to 26% after six months of extraction was reduced to negligible amounts (0.5%) by nine months due to oxidation to *t*-caryophyllene oxide.
- Using Eco-Crop model of DIVA GIS, availability of garcinia in the North Eastern Himalayan states was predicted and six species endemic to NE States were collected.
- New databases on ginger and turmeric germplasm accessions were developed and hosted on the Institute website. A repository of PCR primer sets, useful for the identification and detection of *Phytophthora* species, was developed and uploaded. It includes all the universal primers and species-specific primers for more than 30 species of *Phytophthora* published in literature.
- More than 30 Success Stories and 75 news items have been given through print media.

ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES, KOZHIKODE

The All India Coordinated Research Project on Spices (AICRPS) with its headquarters at IISR, Calicut is vested with the mandate to conduct and coordinate research in 12 spices crops. In the Region No. VIII there are ten Centers and the details are as follows:

AICRP Spices Centers and the mandate crops in Region No. VIII

Centre / Universities	Crops	State
Pampadumpara (KAU)	Cardamom & black pepper	Kerala
Panniyur (KAU)	Black pepper	Kerala
Ambalavayal (KAU)	Black pepper, ginger & turmeric	Kerala
Myladumpara (Spices Board)	Cardamom	Kerala
Mudigere (UHS)	Black pepper & cardamom	Karnataka
Sirsi (UHS)	Black pepper	Karnataka
Sakleshpur (Spices Board)	Cardamom	Karnataka
Coimbatore (TNAU)	Turmeric, coriander & fenugreek	Tamil Nadu
Yercaud (TNAU)	Clove, nutmeg, cassia, cinnamon & black pepper	Tamil Nadu
Pechiparai (TNAU)	Clove, nutmeg, cassia, cinnamon & black pepper	Tamil Nadu

Status of Research

KERALA

Cardamom Research Station – Pampadumpara

- Black pepper: Application of potassium phosphonate 0.3% as spray and drench along with soil application of 50 g *Trichoderma harzianum*/vine is recommended for the management of *Phytophthora* foot rot in black pepper.

Pepper Research Station – Panniyur

- Black pepper: Spraying of potassium phosphonate (0.3%) + *Trichoderma harzianum* MTCC-5179 50 g/vine during May-June and July-August is recommended for the management of *Phytophthora* foot rot disease.

TAMIL NADU

Horticulture College & Research Institute, Coimbatore

- Turmeric: For foliar disease in turmeric, spraying with Propiconazole @ 0.1% on 45 and 90 days is effective and recommended for reducing the leaf spot intensity and leaf blotch with highest yield of 38.92 t/ha turmeric with C:B ratio of 1 : 4.6.

Horticultural Research Station, Yercaud

Black pepper

- Two or three noded stem cutting with 1000 ppm IBA dipping is recommended for good establishment of black pepper cuttings.
- Application of FYM at 10 kg coupled with *Azospirillum* 50 g, Phosphobacteria 50 g and VAM 200 g per vine is recommended for high productivity in black pepper

KARNATAKA

Horticultural Research Station, Sirsi

Black pepper

- Panniyur – I and Ademane pepper are the superior black pepper varieties identified for cultivation in Uttara Karnataka region for high yield and net return.
- Panniyur – I, Ademane pepper and Kudragutta cultivars are identified for cultivation in arecanut mixed cropping system.
- Phytophthora foot rot of black pepper under arecanut cropping system could be managed by complementary application of vines with potassium phosphonate @ 0.3% as spraying @ 2 l/vine and drenching @ 3 l/vine and application of bioagent *T. Harzianum* @ 50 g with one kg neem cake as soil application per vine during first week of June and third week of August to the root zone.
- In black pepper, integrated use of organic and inorganic fertilizers is recommended for higher yield.

Horticultural Research Station, Mudigere

Black pepper

- Management of mussel scales in black pepper by three sprays of neem oil 5 ml or fish oilrosin 3 g/l at 15 - 20 days interval from onset infestation.
- Management of Anthracnose disease by spraying of propiconazole 0.1% twice in a year (May- June and August-September) for control of as an alternative to 1.0% Bordeaux mixture spraying

Cardamom

- For the management of cardamom shoot fly, spraying of Thiamethozam 1g/l during onset of shoot fly infestation in newly planted cardamom field.

DIRECTORATE OF CASHEW RESEARCH, PUTTUR

Status of Research for the period 2010 and 2011

Crop Improvement

- In the National Cashew Field Gene Bank (NCFGB), 527 diverse cashew germplasm have been conserved so far. During the year 2010 and 2011, thirty three germplasm accessions planted in 1999-2000 and 2000-2001 were evaluated and characterized as per IPGRI descriptors bringing the total number of accessions evaluated so far to 452.
- The hybrids H-43, H-66, H-68, H-125 and H-126 yielded 5.20, 6.25, 6.55, 5.95 and 5.70 kg of nuts/tree, respectively with a cumulative yield of 35.33, 34.61, 35.55, 37.60 and 34.39 kg/tree, respectively for seven harvests.
- A total of 105 accessions of germplasm were finger printed using RAPD and IISR primers. RAPD analysis revealed low diversity existing among the accessions.

Crop Management

- Foliar spraying of cashew plants with different concentrations of major (N, P and K) nutrients resulted in higher number of bisexual flowers (upto 17.8%) compared to control (13.8 %). Similarly, application of secondary and micronutrients (Mg, Zn and B) produced higher number of bisexual flowers (upto 20.2%) compared to control (13.1%).
- Among the different varieties planted in four different spacings (10 m x 5 m; 6.5 m X 6.5 m; 6.5 m X 4 m and 5 m X 4 m), the yield was highest in Madakkathara-2 followed by Bhaskara.

Among different densities, the plant density of 500 plants/ha with Madakkathara-2 gave the highest yield (1.6 tonnes/ha).

- Application of biofertilizer consortia along with fertilizers resulted in a higher population of bacteria ($23.2 \times 10^5/g$), fungi ($12.5 \times 10^3/g$), actinomycetes ($19.21 \times 10^5/g$), N-fixers ($4.28 \times 10^2/g$), and P solubilizers ($5.89 \times 10^4/g$) compared to other treatments.

Crop Protection

- Three different species of entomopathogenic nematodes viz., *Steinernema bicolorata indica*, *Heterorhabditis indica* and *Steinernema abbasi* were tested for their virulence to the grubs of cashew stem and root borers (CSRB) *Plocaederus* spp. and *Batocera rufomaculata*. *Steinernema bicolorata indica* was most virulent to *Plocaederus* spp while *Heterorhabditis indica* was most virulent to *Batocera rufomaculata*.
- Co-existence of four species of tea mosquito bugs viz., *Helopeltis antonii*, *H. bradyi*, *H. theivora* and *Pachypeltis maesarum* was observed in cashew plantations. Among these, *Helopeltis antonii* and *H. bradyi* were the dominant species.
- Residues level in the cashew apples fell below the Maximum Residue Limit within 15 days of treatment with λ -cyhalothrin (0.003%) and carbaryl (0.1%)
- A total of 24 species of spiders was recorded to feed on pests of cashew.

Post Harvest Technology

- Dryer for raw cashewnuts with dual mode (electrical and biofuel power operated) was fabricated and installed. Freshly harvested nuts could be dried to safer moisture level of 8 % d.b. within a short period of 2.5 - 3 h. The drying cost was Re 0.44 per kg.
- A continuous type compact drum roasting machine for raw cashewnuts was designed and developed. Studies indicated that raw cashewnuts exposed to temperature between 350-450°C yielded cashew kernels of desired whiteness index.

Transfer of Technology

- The ultra high density (3m x 3m) planting indicated that the productivity can be enhanced to more than 2 tonnes /ha in second year of planting itself.
- About 3.5 lakh cashew grafts of high yielding and recommended varieties were produced and supplied to the farmers and developmental agencies all over India.

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON CASHEW

AICRP on Cashew has ten main centres and one sub centre and three Cooperating Centres. One main centre at Madakkathara (KAU) and one sub-centre at Pilicode (KAU) are in Kerala; one main centre at Chintamani (UAS) and one Cooperating Centre at Arabhavi under UHS, Bagalkote are situated in Karnataka; one main centre at Vridhachalam (TNAU) is located in Tamil Nadu.

The details of area, production and productivity in different states are presented below:

State	2010			2011		
	Area (ha)	Production (t)	Productivity (kg/ha)	Area (ha)	Production (t)	Productivity (kg/ha)
Kerala	72000	66000	957	78000	71000	947
Karnataka	118000	53000	461	119000	57000	491
Tamil Nadu	133000	60000	472	135000	65000	507

1. Status of Research for the period 2010 and 2011

Agricultural Research Station, Chintamani (UAS), Karnataka

- Under germplasm evaluation trials at Chintamani, 44/1-ARSC (Vengurla-5) recorded the highest cumulative yield of 359.23 kg/tree in 22 harvests.
- Over a period of 15 harvests, H-320 recorded highest cumulative yield of 131.85 kg/tree under MLT-II.
- During 2011, under multi-location trial-III, the highest nut weight of 9.29 g was recorded in BH-6 followed by 9.19 g in H-1593.
- Under spacing and fertilizer trials, the highest nut yield of 23.04 q/ha was recorded in 600 plants/ha during 2011.
- During 2011, the damage score due to tea mosquito bug (TMB) was least (1.69) in recommended spray schedule.
- Chlorpyrifos (0.2%) was proved to be effective with 94.21% of treated trees without reinfestation by cashew stem and root borer (CSRB) during 2011.

Cashew Research Station, Madakkathara (KAU), Kerala

- Highest cumulative yield for 3 harvests was recorded by Pathanoor (11.85 kg) followed by Kunjithai (10.90 kg) in germplasm evaluation trials.
- The highest cumulative yield for 14 years in Madakkathara was recorded in H-303 (68.14 kg/tree) followed by H-320 (59.47 kg/tree).
- During the year 2010, the highest cumulative yield was 58.9 kg/tree in H-303 followed by 51.37 kg/tree in H-320 in varietal evaluation trials.
- During 2011, the maximum cumulative yield of 41.29 kg/tree for 6 harvests was obtained with 750 : 325: 750 g NPK/tree under fertilizer trials.
- A nut yield of 1455 kg/ha from 500 trees/ha was obtained in fertilizer and density evaluation trials during 2011.
- Chlorpyrifos (0.2%) could lead to more than 90% recovery of treated trees without reinfestation CSRB during 2011.

Regional Research Station, Vridhachalam (TNAU), Tamil Nadu

- The accession KK-1 recorded highest nut weight of 7.8 g and highest shelling percentage of 28.5 in germplasm evaluation during 2010. During 2011, TK-1 recorded the highest cumulative nut yield of 37.03 kg/tree in 9 years.
- The hybrid HC-6 showed 68.75% reduction in internodal length when compared to HC-9, the tallest hybrid in hybridization trial during the year 2011.
- The maximum cumulative yield of 3.14 kg/tree for two harvests was obtained under drip irrigation at 60% CPE.

Details of cashew grafts produced out by different centres of AICRP-Cashew

Centre	No. of grafts produced during 2010	No. of grafts produced during 2011
Chintamani	7500	12000
Madakkathara	72000	75000
Pilicode	75000	37000
Vridhachalam	60400	116650

CENTRAL TUBER CROPS RESEARCH INSTITUTE, THIRUVANANTHAPURAM

Salient Research Achievements

Cassava

- In the Advanced Yield Trial of 14 CMD resistant cassava hybrids, CR 21-10 recorded the highest extractable starch content (30%) followed by CR20A-2 (27.2%) and S1284 (26%).
- Among 50 CMD resistant cassava clones evaluated for earliness, CR52A-41 and CR20A-2 recorded high dry matter (> 40%) and starch (> 28%) at sixth month after planting. The clones CR 20A-2, CR42-3, CR52A-41, 9S272, 9S107, 9S127, 9S165 and 9S174 recorded earliness coupled with CMD resistance, low cyanogen content and good cooking quality.
- Among 13 clones, CPT 32 recorded the higher true protein content (6.1%) followed by CPT13 (5.9%) and CPS30 (5.2%) on dry weight basis as compared to 1.9% in M4 and 2.2% in Sree Padmanabha. CPT 32, CPS 30, CPT 20, CPT 40 with significantly higher protein content than the released /popular varieties were identified for on farm trials.
- The long term fertilizer experiment indicated that FYM as a source of organic manure for cassava @ 12.5 t/ha can be substituted with other organic sources like green manuring *in situ* with cowpea, crop residue, vermi compost and coir pith compost.
- Need based application of FYM and NPK based on soil test is as good as the POP recommendation of FYM @ 12.5 t ha⁻¹ and NPK @ 100:50:100 kg/ha.
- A total of 41 bacterial isolates from cassava rhizosphere were characterized for their beneficial properties. Nine isolates showed antagonistic activity against *Sclerotium* and most of the rhizobacteria showed more than three PGP traits.
- Carotene-enriched functional pasta was made from cassava using dehydrated pumpkin powder as carotene additive. It raised the swelling index and reduced the cooking loss besides *in vitro* starch digestibility indicating its use as a low glycaemic food.
- A ready to eat extruded snack food product was developed from cassava rice flour blends which had high expansion ratio and good textural quality.
- Cassava starch based biodegradable film with antimicrobial activity was developed by adding garlic, clove or cinnamon oil in the starch-glycerol-gum composites.
- ARIMA model for cassava was developed for price forecasting. Average difference between observed and predicted prices using the forecasting models was 1 % in case of both crops.
- For studying CMD resistance in cassava using association mapping, a total of 14 CMD associated SSR markers are selected for studies with five resistant, five recovery and five susceptible lines. Only eight markers amplified and no marker showed clear difference between CMD resistant and susceptible lines.
- In cassava drip irrigation at 100% CPE out yielded irrigation at 80 and 60 % CPE respectively.

Sweet Potato

- Evaluation of 15 white-fleshed clones of sweet potato for three seasons showed that highest yield (21-30 t/ha) was recorded in IGSP-22 followed by IGSP-10-6 (18-27 t/ha). The clones SV3-27-5, IGSP-14-6, and IGSP-10-24 also produced significantly higher yield (19-24 t/ha) compared to the control Sree Arun (17-20 t/ha).
- Full length genome of sweet potato leaf curl virus (SPLCV) was sequenced and annotated.
- An anthocyanin based drink was developed on lab scale from the sweet potato variety ST 13 with stable colour, excellent radical scavenging activity and good taste.

Yams

- True protein content of 10 promising *D. alata* accessions was evaluated. Da 11 recorded the highest true protein content of 13.3% and 4.0% on dry and fresh weight basis respectively.
- The field gene bank of greater yam was screened to identify anthracnose resistant accessions. Da11 and Da68 expressed field tolerance to anthracnose disease.
- Among 1276 *D. alata* clones derived from seedlings 512 (40.1%) were selected on the basis of compact tuber shape, and cooking quality and dry matter content. The dry matter ranged from 15.7 – 38.3%. There were 24 clones having dry matter content of more than 30%.
- Rapid growth of yam meristem culture has been obtained through different combinations of hormones and explants source. The nodal and meristem cultured plants were made virus-free through chemotherapy with quercetin 15 mg/l, thermotherapy at 36° C for 45 days and combination of chemo-thermotherapy (Quercetin 10 mg/l and thermotherapy at 36° C for 45 days) and hot water treatment at 36° C for 30 minutes.

Aroids

- Seven advanced hybrid selections of *Amorphophallus* having stability in yield (38- 42.5 t/ha), good cooking quality and free from diseases were identified for AICRP trials.
- In yams and taro, organic farming was on a par with conventional practice. Soil pH and organic C status were significantly favoured due to organic farming in taro.
- Application of biofertilizers along with *Pseudomonas fluorescens* and biocontrol agent, *Trichoderma* in the *Amorphophalus* revealed the possibility of substituting chemical fertilizer to the tune of 25 - 75%.
- The virus associated with mosaic disease of elephant foot yam has been identified as Dasheen mosaic virus (DsMV). A RT-PCR based diagnostic technique for diagnosis of DsMV infecting elephant foot yam, taro and tannia has been developed.
- Wide variations in the content of starch, sugar, phenols and oxalates were observed in some selected germplasm accessions of *Colocasia*. In two accessions, calcium oxalate was not detected and the oxalates were present only in soluble form.
- Fourteen accessions were identified for Taro Leaf Blight (TLB) resistance in initial screening. IC 336476 from Jharkhand showed the lowest disease incidence at 3.8%.
- A tannia cultivar with a mean yield of 1.2 kg/plant and good cooking quality was found suitable for on farm trials based yield stability in the over three consecutive seasons.
- In tannia, application of dolomite @ 1 t/ha (82 g/plant), FYM @ 25 t/ha and NPK @ 80:50:150 kg/ha was found effective in ameliorating the soil acidity induced Mg deficiency.

General

- Two triploid cassava, 4-2 and 5-3 which are popular in Tamil Nadu for industrial use were registered by the Plant Germplasm Registration Committee (PGRC).
- 1042 accessions of the different tuber crops were maintained in the In vitro Active Gene bank. This included cassava (634), sweet potato (298), yams (72), wild species of *Dioscorea* (28), *coleus* (5) and *Colocasia* (5).
- *In vitro* cultures of medicinal species of different tuber crops genera like *Alpinia* (3 spp) *Asparagus racemosus*, *Canna edulis*, *Curcuma* sp., *Curculigo ocheoides*, *Costos speciosus*, *Dioscorea* (14 sp), *Globba* sp., *Hedichium coronarium*, *Hornstedia fenizilii*, *Kaempferia* spp. (3 spp), *Maranta arundinaceae* and *Tacca leontopetalloides* are being maintained.

- A total 1222 accessions including Colocasia (517) *Amorphophallus* (124), *Dioscorea* (105), costus (15), cassava (21), sweet potato (24), *Tacca leontopetalloides* (4), *Alocasia* (12), *Xanthosoma* (10), *Kaempferia* spp. (3) and *Coleus* (5) were maintained in shade net houses and in field.
- A joint germplasm exploration was conducted in the Lakshadweep islands and 19 accessions were collected from the 5 islands including the uninhabited Suheli-Cheriyakara Island.

Technologies ready for transfer

Cassava

- A nutrient decision support system website, cassava site specific nutrient management (CASSNUM) containing cassava site specific nutrient calculator (CASSNUT) and cassava site specific nutrient disorders (CASSNUTD).
- Two biopesticides from cassava: one each against borer pests and sucking pests.
- Mealy bug prediction software to predict the dynamics of *Paracoccus marginatus* on cassava.
- Biofumigant isolated from cassava leaf to manage pseudo stem weevil in banana.
- Carotene – enriched functional pasta and gluten free cassava-rice pasta.
- Cassava based biodegradable film with antimicrobial activity and cassava starch based superabsorbent polymer.

Sweet potato

- High carotene sweet potato pasta.

Yam

- Soil and tuber treatment with *Trichoderma* and spraying SAAF at 0.1% thrice at fortnightly interval to control *Colletotrichum gloeosporioides*, causing anthracnose disease in greater yam.

Aroids

- Application of vermiwash at 1, 2, 4, 8 and 16 % on taro leaf and elephant foot yam slices could successfully check the pathogen *P. colocasiae* and *S. rolfsii* invasion respectively.

Production of Quality Planting Materials

Tapioca stems –	60,000 Nos.
Sweet potato vines –	425,000 Nos.
Elephant foot yam –	25,000 kg
Greater yam –	19,000 kg
White yam –	200 kg
Lesser yam-	150 kg
Taro –	672 kg
Arrow root –	600 kg
Yam bean seeds –	20 kg

ALL INDIA COORDINATED RESEARCH PROJECT ON TUBER CROPS

Salient research achievement during 2010 and 2011

The AICRP on Tuber Crops has two centres in the Region No. VIII, one each under TNAU (Coimbatore and Yethapur) and UHS, Bagalkot (Kumbapur, Dharwad). The mandate crops at Coimbatore Centre are sweet potato, aroids and yams and at Yethapur, cassava. At Kumbapur center, the mandate crops are sweet potato, cassava and yams.

Genetic resources

- Yethapur centre (TNAU) is maintaining 364 accessions of cassava.
- Coimbatore centre is maintaining 70 accessions of sweet potato and 10 accessions of taro.
- UHS, Bagalkot is maintaining 92 accessions of sweet potato and 5 accessions of taro.

Varietal evaluation

- Cassava IET line ME-833 recorded significantly higher yield of 41 t/ha at Yethapur.
- The cassava variety MNga-1 showed resistance to cassava mosaic disease at Yethapur yielding 29 t/ha.
- In the multi-location trials of sweet potato, IGSP-14 reported maximum yield (24 t/ ha), while Kamala Sundari gave an yield of 22 t/ha Coimbatore.
- At the Kumbapur centre, sweet potato variety Kamala Sundari recorded significantly higher tuber yield of 29 t/ha.
- In the IET of elephant foot yam, Appakudal local gave significantly higher yield of 50 t/ha at Coimbatore.

Agro-techniques

- In drip irrigation trial, the treatment 75% CPE + RDF 100% as fertigation and 100% CPE + RDF 100% as fertigation in elephant foot yam gave higher yield at Coimbatore.
- INM on sweet potato at UHS Kumbapur centre gave comparable tuber yield to other centres.

Tuber crops as intercrops in orchards

- Intercropping in mango orchard with sweet potato and cassava gave satisfactory results.

Pest and disease management

- Sweet potato weevil could be managed with border crop of yam bean or marigold.
- Sweet potato viruses were noticed in certain areas. Cassava mosaic was occurring in serious proportions in Tamil Nadu. Recently a mealy bug attack was noted in severe form in Tamil Nadu.
- Bio-pesticides from tuber crops: cassava leaf extract was found to be effective as a bio-pesticide against cassava mealy bugs.

Planting material distribution and Extension activities:

Cassava varieties H-165, H-226, CO-TP-4 and MNga-1 were multiplied and about 10000 stems were distributed among the farmers of Tamil Nadu. About 10000 vines have been multiplied by the Kumbapur centre for distribution among farmers.

CENTRAL POTATO RESEARCH STATION, MUTHORAI, THE NILGIRIS

The Central Potato Research Station working on the basic problems of potato production in the Nilgiris has identified three important potato production problems as the foremost and is working out strategies to overcome them. The major problems are: i). Non-availability of quality seed potatoes, ii). Late blight disease, and iii) Potato cyst nematodes.

Recommended varieties:

- K. Swarna, K. Jyoti, K. Giriraj, K. Himalini and K. Girdhari
- The new variety K. Girdhari is preferred by the farmers due to its resistance to late blight and high yielding capacity having attractive shape and good cooking quality.
- Kufri Swarna is having resistance to both late blight disease and potato cyst nematodes and it is the only variety available with combined resistance to both these dreaded problems.
- K. Jyoti, although its resistance to late blight disease has broken down is cultivated even today in Nilgiris.
- K. Giriraj is a high yielder and its resistance to late blight is slowly breaking down.
- K. Himalini is also performing well in Nilgiris and it is resistant to late blight.

Significant achievements and important package of practices

- One hybrid, OS/93-D-204 developed at the station has been recommended for release as "Kufri Neelima" in the 27th Group Meeting of Potato Workers held at UAS, Dharwad. The variety is approved for release as TNAU Kufri Potato 1 from Tamil Nadu State Varietal Release Committee.
- Another high yielding hybrid, OS/01-516 having combined resistance to cyst nematodes and late blight disease has been introduced into AICRP and undergoing multilocation tests in farmer's field in Nilgiris.
- A decision support system for Crop Scheduling of potato in Nilgiris has been developed using INFOCROP potato model with Kufri Jyoti variety. This is very useful to take decisions on planting and harvesting time during summer and autumn seasons in Nilgiris.
- Yield stability in potato was evaluated under different recommended soil management practices. The improved practice of intercropping potato + French beans in summer followed by cabbage crop in the autumn recorded higher potato equivalent yield and also lower cyst nematode population with good yield stability.
- Growing cabbage and resistant potato at least once in two years can bring down the nematode population substantially. Growing radish is another effective rotational system to contain PCN population.
- Varietal differences were observed with reference to date of planting. The advance hybrid OS/93-D-204 performed better when planted in the first week of April. For Kufri Giriraj it is second week of April and for Kufri Swarna it is the third week of April i.e., normal recommended date. In case of Kufri Jyoti the best date was first week of May.
- Among the nematicides, carbofuran performed better than phorate in suppressing PCN and improving potato yield. There was a marginal increase in potato yield and suppression of PCN population with increase in dosage of nematicides.
- Application of organic amendments reduced the PCN multiplication and improved the potato yield compared to the untreated control. Among the treatments, neem cake in combination with *T. viride* recorded maximum increase in yield and reduction in PCN multiplication.

- Among the biocontrol agents tested, *Pseudomonas fluorescens* gave maximum reduction in PCN multiplication and improvement in potato yield followed by *Paecilomyces lilacinus*.
- Field application of CCC @ 100 ppm (2 sprays at 60 and 75 days after planting) and soaking the harvested seeds in the same solution for 20 minutes before storage can prolong the storability of potato seeds for 6 months under normal conditions of storage in Nilgiris
- Among the different shapes of scoopes tried as planting material, semicircular shaped scooped eye is better suited for Kufri Jyoti and Kufri Giriraj varieties, whereas, cone shaped scooped eye was found suitable for K.Swarna variety.
- Among the different methods of storage of scooped eyes, storage in sand for 90 days produced higher yield of both seed sized as well as total tuber yield.

Multiplication of planting material

- 203 tonnes of quality potato seeds of recommended varieties was produced during the last two years and 144 tonnes was supplied to the Dept. of Horticulture/local farmers.

Technologies ready for transfer

- Variety: The newly released cyst nematode and late blight resistant variety NAU Kufri potato 1 (K. Neelima) is ready for transfer. The seeds are being multiplied for supply to Horticulture Department and farmers.
- Potato + French beans inter cropping: The intercropping of potato + French beans in 66 : 44 proportions (3:2) improves the potato equivalent yield of the system by 10 % over sole potato.

DIRECORATE OF OILPALM RESEARCH, RESEARCH CENTRE, PALODE

Progress and achievement

Field gene bank

- The centre has 62 accessions planted as field gene bank. More than 50% of the accessions are either teneras or materials introduced from secondary sources.
- Two accessions of *Elaeis oleifera* were introduced from an exotic source.
- Large numbers of drought and cold tolerant accessions were prospected and collected from Guinea Bissau, Cameroon, Zambia and Tanzania and these are being evaluated
- The evaluation of germplasm resulted in identification of 20 individual palms possessing important economic traits such as long stalk, dwarfness and early bunch ripening.
- The passport data for African germplasm has been compiled and reported to NBPGR, New Delhi.

Dura improvement

- 84 mother palms are being used for commercial seed production and 56 elite palms have been identified.
- Advanced generation parent materials were evolved through reciprocal recurrent selection.
- Annually 3 lakhs seeds are produced using parental palms for commercial cultivation.

- Seed dormancy breaking technique was evolved to achieve speedy & uniform germination.

Tissue culture hybrid: The palm growth is normal and there is no report of abnormality in bunch and fruits of palms established from zygotic embryos.

***Elaeis oleifera* base population:** One palm showed dwarf character with high yield

Interspecific hybrids: Promising dwarf interspecific hybrids, namely 47 (361Eg × 11Eo), 48 (16Eo × 18Eg) and 6 (12Eo × 82Eg) were identified and subjected to backcrossing with elite pisiferas

Crop production

- Oil palm nursery management techniques were standardized.
- Techniques for vermi-composting oil palm plantation waste have been developed.
- Fertilizer and water management practices for adult plantations were perfected under rainfed conditions.
- Integrated nutrient management was evolved by way of nutrient recycling. Suitable cropping systems were developed for established oil palm gardens.

ACTION PLAN

Enrichment of germplasm, maintenance, evaluation and cataloguing: Cataloguing and updating germplasm register and descriptor for selected accessions will be continued. This Centre will survey Kerala, Tamil Nadu and A&N islands for collection of dura and tenera palms for enrichment of germplasm.

Development of dwarf varieties from *oleifera* sources

- The high yielding potential dwarf palm (Palm No 48) will be subjected to backcrossing and forwarded to F3 by crossing with good pisifera palm and F3 progeny shall be planted at Palode campus.

New seed garden using advanced materials: Next generation advanced materials are to be produced at the centre using high yielding potential palms available at Palode / Thodupuzha / Athirapilli.

CHAPTER VI

STATUS OF RESEARCH IN NATURAL RESOURCES MANAGEMENT

UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

Technologies recommended for inclusion in the Package of Practices

Crop Production

- Application of 5 t/ha of enriched compost with bio-fertilizers (such as *Azotobacter*, PSB and *Trichoderma viridae*) along with 50 % N & P and 100 % potash to groundnut gives 38 % higher pod yield compared to control with BC ratio of 2.77.
- Application of zinc sulfate @ 10 kg/ha along with borax @ 6 kg/ha gives higher groundnut pod yield of 13.6 q/ha and kernel yield of 8 q/ha with BC ratio of 3.34.
- Application of bio-digester liquid manure with FYM to crops such as paddy, ragi, maize, groundnut & horticultural crops gives higher yields. Hence bio-digester model has been recommended for inclusion in the Package of Practices.
- Cultivation of cowpea / horsegram – lucerne as intercrop in hybrid Napier recorded highest green biomass yield (149 q/ha) with additional crude protein yield (7.0 q/ha) over sole crop of hybrid Napier with 138 q/ha and crude protein yield of 23.03 q/ha.
- Cultivation of cowpea / horsegram – lucerne as intercrops in coconut garden recorded green forage yield of 550 q to 650 q/ha and also improvement in soil fertility.
- Production package for fodder cowpea (KBC-2) with spacing of 30 x 10 cm with seed rate of 35 kg/ha and nutrient requirement of 25:50:25 NPK kg/ha recorded green forage yield of 250 q/ha.
- Growing of greengram during pre-monsoon season and sunnhemp during Rabi season in paddy-paddy system under residual moisture helps in achieving higher yield in Zone 7.
- Dibbling of bold seeded French bean on either side of cotton seed with recommended dose of fertilizers facilitates better germination in the event of heavy rainfall immediately after sowing cotton followed by dry spell. This prevents crust formation besides higher yield of 10 and 25 % as compared to recommended and farmer's practice respectively.
- Application of lime sludge to soils with pH less than 6.0 increases pod yield of groundnut upto 36 % and enhances shelling percentage by 7.3. Thus, lime sludge can be used as a cheaper source of liming material in acid soils instead of agricultural lime stone in Zone 7.
- Soil application of ZnSO₄ @ 5 kg/ha + Borax @ 1 kg/ha as micronutrients with RDF to Sesamum var. TMV-3 recorded 18.79 % higher yield (3.45 q/ha) at Zone 6.
- Spacing of 60 x 20 cm with 150 % RDF and 7.5 t of FYM/ha is recommended for high grain (47 q/ha) and straw yield (117 q/ha) in case of Nityashree hybrid maize. Further, application of ZnSO₄ @ 20 kg/ha enhanced the yield significantly.
- Application of 30 kg N along with 75 kg P₂O₅ and 60 kg K₂O/ha together with seed treatment with 150 g *Azotobacter chroococcum*/kg of seed give higher yield of 16 q/ha in sunflower hybrids KBSH-41&53 in Zones 4 & 5.
- Sowing of castor in July with 120 x 60 cm spacing recorded higher yield under rainfed situation in Zone 7.
- Split application of potassium @ 60 kg/ha in equal three splits, viz., at basal, 25 – 30 and 50 – 55 days after planting along with N for transplanted rice in midland and lowland conditions was found to give 12% higher yield compared to recommended practice.
- Spraying soluble silicic acid @ 4 ml/l for 4 times from 21st day after planting at an interval of 15 days increases the grain & straw yield of rice beside reducing the pest and disease incidence and chaffiness in paddy.

Weed Control

- Application of Bensulfuron methyl (0.6%) + Pretilachlor (6.0% G) @ 10 kg/ha mixed with 75 kg sand and broadcasted within 5 days after transplanting can effectively control weeds in transplanted rice with B:C ratio of 2.38 compared to farmer's practice i.e., Butachlor (50 EC 1.5 kg a.i./ha at 3 DAT) of 2.15.
- Pre-emergent herbicide butachlor 50 EC @ 2.0 l/ha and pendimethalin 30 EC @ 3.25 l/ha is recommended as additional herbicides for weed management in cotton for Central Dry Zone.
- Weeds in sprouted rice in coastal zone can be managed by use of pyrazosulfuron ethyl 10 WP @ 250 g/ha at 3 DAS in drum seeding or broadcasted rice and also gave higher yield and monetary returns compared to other weed management practices.

UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

Technologies Developed

- Effect of planting methods and moisture conservation on yield potential of sorghum.
- Sulphur nutrition in soybean.
- Management of foliar diseases of groundnut using Tebuconazole 250 EC.
- Insecticidal management of *Spodoptera litura* in groundnut crop.
- Organic management of *Spodoptera litura* on groundnut crop.
- Transverse stent sutures for tendon repair in bullocks.
- Modifications to fertilizer doses for Bt Cotton under assured rainfall/irrigated conditions.
- Compartment bunding in *Rabi* Sorghum
- Deena Bhandu (dome shaped) bio gas plant.

UNIVERSITY OF AGRICULTURAL SCIENCES, RAICHUR

Response to the package of practices

- Moisture Conservation in pigeonpea: Moisture conservation techniques like opening of furrows between 2 rows at 30 days after sowing will enhance the yield.
- Management of spotted pod borer in pigeonpea: Application of profenophos 50 EC @ 2.0 ml and ADVP 76 EC @ 0.5 ml / lit of water at bud to flowering stage of the crop for zone 2.
- Management of pod borer in pigeonpea: Application of Rynaxypyr 20 SC @ 0.15 ml/l of water as fourth spray for zone 2.
- Management of blast in paddy: Application of Isoprothiolace 5 EC @ 1.5 ml/l of water.
- Management of Sheath blight of paddy: Application of Hexaconazole 5 EC @ 1 ml/l of water.
- Management of Alternaria in seasmum : Application of Mancozeb 75 WP @ 2 g at 35 days after sowing and application of Pseudomonas florescence 5 g/l after 50 days.
- Lufenuron 5 EC against chilli defoliator and fruit borer: Application of Spray Lufenuron 5 EC @ 1 ml/l for the management of Spodoptera and Fruit borer.

- Rynaxypyr 20 SC against Chilli fruits borer : For the management of chilli fruit borer spray 5% NSKE at 7th and 11th week after planting or spray 5% NSKE at 7th week after planting and NRV (250 LE) at 11th week after planting or spray Rynaxypyr 20 SC @ 0.25 ml/l.
- Indoxacarb 15.8 EC in the list of brand name instead of indoxcarb 14.5 SC : Avant 15.8 EC
- Integrated pest management in groundnut includes seed treatment with trichoderma and Rhizobium, application of neem cake, growing trap crops, use of pheromone traps, collection and destruction of egg masses and early instars of *Spodoptera*, spraying 5% NSKE, use of *Spodoptera* NPV, poison baiting with monocrotophos and spraying Profenophos
- Thiamethoxam 35 FS against sunflower sucking pests : Seed treatment with Thiamethaxam 30% FS @ 10 ml/kg of sunflower seed.
- Management of sunflower defoliators: Foliar spray of Indoxacarb 14.5 SC @ 0.3 ml/l or Spinosad 45 SC @ 0.1 ml/l for the management of sunflower defoliators.
- Management of Chickpea wilt: To control wilt in chickpea seed treatment with *Trichoderma* @ 4 g/kg seeds along with application of mixture of 2 kg *Trichoderma* with 250 kg powdered FIM and 50 kg powder of Neem seeds which was prepared with 50% moisture in the plastic cover kept for 7 days.
- Management of Rose Powdery Mildew : To control powdery mildew of Rose spraying of 1g Carbendizim 50 WP or 0.5 ml Tridomarfa 50 EC or 0.5 ml Difenconazole 25 EC per litre of water.

UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT

Research Highlights

- Coconut based farming systems with medicinal plants like Kalmegh, Tulsi & lemon grass as intercrops in coconut have been standardised and found to be highly economical than sole coconut.
- A new cashew variety NDR-2-1 with higher shelling percentage (32%), high kernel count (210/kg) and high seed yield (21 kg/plant) has been identified.
- Soil salt tolerance levels have been identified for winter vegetables like knolkhol (6 to 8 ds/m), cabbage (2 to 6 ds/m), cauliflower (6 to 8 ds/m), onion (4 to 6 ds/m), carrot (4 to 6 ds/m) and sweet potato (4 to 6 ds/m).
- Sapota leaf spot disease management has been standardised. Two sprays of carbendazim @ 0.1% was effective
- Management of koleroga and damping off of arecanut has been standardised : Spraying with 2 g Metalaxyl MZ-72 to the affected and surrounded trees followed by 1% Bordeaux mixture, after 10-15 days of first spray
- Cultivation practices for flower crops like Bird of Paradise and *Heliconia* and medicinal crop Ashwagandha have been standardised for the northern Karnataka
- Integrated Nutrient Management for sapota has been standardised for higher yield [10 kg Vermicompost + 400:80:300 g of NPK was found good]
- The *in-situ* soft wood grafting technique in Jamun has been standardised with over 80% success.
- Spacing of 60 cm X 20 cm and 50:50:50 kg/ha of NPK has been found optimum for higher yield in Coleus.
- Galfly resistant *Erythrina subumbrance* has been identified for betel leaf live standard.

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

Salient Achievements of during 2010 and 2011

Crop Production

- The best integrated nutrient management for high grain and straw yield in rice is 25% recommended dose of fertilisers (RDF) through organic manure in kharif and 75% of RDF through inorganic fertilisers in rabi with a saving of 25% of the chemical fertilizers and superior physico chemical and biological properties of the soil.
- Application of fertilizers more than the Package of Practice recommendation of KAU (70: 35: 35 kg NPK/ha for short duration and 90:45:45 kg NPK/ha for medium duration varieties) is not found profitable in Kuttanad soils.
- Sodium as common salt is found to substitute potassium as muriate of potash to the extent of 25% for rice in well drained wetland soils.
- Sulphur application @ 15 kg/ha is sufficient for sustaining economic production in rice based cropping systems
- Pyrazosulfuron ethyl @20 g ai/ha at 10 DAT is recommended as an efficient and economic weed management practice for low land rice with safety to soil environment and safety of produce for human and animal consumption.
- Bispyribac-sodium is found effective for weed control in transplanted rice with no crop toxicity
- Developed management techniques of stale seed bed and contact application of herbicides using Wick applicator for control of weedy rice
- Tillage was found essential for realizing higher yield from a Rice- Rice- Fallow cropping system in the double crop wetlands of Kuttanad.
- Relay cropping of rice-rice-yard long bean and rice-rice-Amaranthus is found to give more net return in the rice fallows.
- The residues of butachlor and pretilachlor (Cyhalofop butyl) herbicide was not detectable after application of recommended dose in rice soils.
- Developed a nutrient management technology (100% NPK as organics + trash application with cellulolytic culture + biofertilizers) in ratoon crop of sugarcane for highest cane and sugar yield with optimum juice quality.
- Zinc nutrition in the form of zinc sulphate @ 20kg/ha was yielded more in sugar and quality in sugarcane.
- Perennial bajra with Napier hybrid is found as the best fodder based cropping system with highest yield and net returns under irrigated condition.
- Successful organic cultivation packages were evolved for *Rauvolfia serpentina*, *Desmodium velutinum*, *Pseudotheria viscida*, *Nervilia aragona* and *Seidenfia rheedii*.
- Detected antioxidant properties of important medicinal plants and traditional Ayurveda medicines under *in vitro* assay conditions

Plant Protection

- Established a biocontrol & biofertilizer production unit at College of Agriculture, Vellayani in which mass production of biocontrol agents – *Pseudomonas* and *Trichoderma* and Biofertilizers-Azospirillum, Azotobacter, P-solubilizers and AMF and quality analysis of microbial inoculants and samples are being undertaken.

- A formulation technology to sustain virulence and higher shelf life of microbial inoculants including insect biocontrol agents-*Beauveria*, *Metarrhizium* and *Verticillium* has been developed.
- Organisms suitable for organic waste decomposition especially for lignin and cellulose degradation have been isolated from Kerala soils
- Consultancy service for producing biocontrol agents with KAU technology is being provided to all the 32 microbial inoculant production centers
- Standardized the technology for the cultivation of mushrooms viz. *Pleurotus* spp & *Calocybe indica* on rubber dust.
- Standardized and popularized the value added products viz. mushroom wine (Koonamruthu), dried mushroom powder and mushroom sauce from Oyster mushroom.
- Developed technologies for the management of virus diseases of honey bees
- Implemented Integrated Agromet Advisory Service, a multi-institutional programme in collaboration with IMD, ISRO, CUSAT, Planning Board and Department of Agriculture in all 14 districts with KAU expertise.

Agroforestry and silviculture

- Identified *Acacia auriculiformis* and *Artocarpus heterophyllus* as best standards for pepper
- Developed production technology for *Acacia mangium*
- Standardized macropropagation of *Jatropha* and pongam (*Pongamia pinnata*)

ALL INDIA COORDINATED RESEARCH PROJECT ON AGROMETEOROLOGY

The research highlights of four centres, viz., Bangalore, Bijapur, Kovilpatti and Thrissur falling under Region VIII are as under:

Bangalore:

- ✦ Water balance study in a mango orchard was carried out to know the impact of soil moisture on mango yield. Evapotranspiration by mango was reported to be 1120 mm in the year 2010 against its water requirement of 1474 mm.
- ✦ Agromet Advisory Services helped in saving Rs.4,500 by way of avoiding 4 - 5 pesticide sprays in vegetable and field crops besides saving irrigation cost of about Rs.3,000/ha in vegetables.

Bijapur:

- ✦ Analysis of rainfall of six districts of northern Karnataka revealed that the start of rainy season is most delayed (27 Standard Meteorological Week) and duration is shortest (18 weeks) in Raichur district while the start is earliest (22 SMW) and duration is longest (23 weeks) in Uttar Kannada district.
- ✦ Vapour pressure (afternoon) of < 14 mm Hg and minimum temperature of < 16°C during the reproductive period of sunflower were found to be unfavourable for yield.
- ✦ Maximum temperature (ambient and one week before) showed significant negative relationship with flea beetle in grapes while RH showed significant positive relationship.

Kovilpatti:

- ✦ The probability of getting rainfall of 20 mm or more is more than 50 % during 39 to 47 weeks only.

- ✱ In sorghum-based intercropping systems, higher light interception and utilization was recorded during flowering to pod formation in pulses and flowering phase in rabi sorghum.

Thrissur:

- ✱ Peak vapour pressure deficit in February was found to be responsible for high leaf shedding in coconut during April.
- ✱ Low vapour pressure deficit during June to November resulted in lower rate of button shedding in coconut.

PROJECT DIRECTORATE OF CROPPING SYSTEMS RESEARCH

PDFSR, Modipuram has five on-station and five on-farm centers of AICRP on IFS in the states of Kerala, Karnataka, Tamil Nadu and Union Territories of Puduchery and Lakshadweep. The on-station centers are located at Karamana (Kerala); Kathelegere and Siruguppa (Karnataka); and Coimbatore and Thanjavur (Tamil Nadu). The on-farm centers are located at Thiruvalla (Kerala); Bengaluru and Gadag (Karnataka); and Paiyur and Chettinad (Tamil Nadu).

Salient Achievements:

Karnataka

Kathalagere

- ✱ Among the different alternative cropping systems tried, paddy-greengram-paddy-palak recorded the maximum REY (25.5 t/ha/yr.), net returns (Rs.2.03 lakh/ha/yr.), system productivity (69.7 kg/ha/day) and system profitability (559 Rs/ha/day).
- ✱ Application of 75% N + 25 % N through paddy straw recorded maximum REY (11.1 t/ha/yr.), net returns (Rs. 90,274/ha/yr.) and B: C ratio (2.80).
- ✱ Among the different resource conserving rice establishment methods tried, drum seeder and SRI methods recorded maximum rice productivity (10.1 and 9.8 t/ha/yr.), net returns (72,171 and Rs. 70,481/ha/yr.) and B:C ratio (1.85).
- ✱ In maize-groundnut sequence, maximum maize eq. yield (14.7 t/ha/yr.), net returns (Rs. 89,027 /ha/yr.) and B: C ratio (2.48) were recorded by application of 100% NPK + 10 kg ZnSo4 /ha.

Siruguppa

- ✱ Paddy-spinach-greengram and paddy-methi-blackgram systems were the most productive and profitable systems compared to existing paddy-paddy system.
- ✱ Soil fertility and yield stability revealed that balanced fertilizer (120:80:40kg NPK/ha) was the best for sustainable productivity and soil fertility (NPK & S contents) of maize-wheat system.
- ✱ In rice-sesamum cropping system, application of 100 % NPK + secondary and micro nutrients based on soil test recorded the highest grain yield of both rice and sesamum and was closely followed by 50 % NPK+ 50% N (through FYM) + inorganic micronutrients.
- ✱ In maize-bengalgram system, conventional tillage + burning + RDF recorded significantly higher grain yield of maize and bengal gram followed by reduced tillage + burning + RDF + extra 25 % N.
- ✱ In rice-sunflower cropping system, wet cultivation and puddling in kharif with integrated weed management gave numerically superior rice and sunflower yield
- ✱ Drum seeding technique in paddy cultivation: Application of Parthenium alone @ 5 t/ha or FYM @ 2.5 t/ha + Parthenium @ 2.5 t/ha as green manure in paddy cultivation.

Alternate cropping system for paddy-paddy in Tungabhadra project area: Paddy-ridge gourd.

Bengaluru

- ✱ The highest yields were recorded with conjunctive use of N, P & K nutrients for paddy and tomato in Kharif, and tomato, bhendi; cabbage and groundnut during summer. The next best yields were obtained with application of NP nutrients. Nitrogen showed highest response in tomato, bhendi, and cabbage. P₂O₅ and K₂O gave better responses in groundnut.

Gadag

- ✱ Soybean-rabi sorghum cropping system in black soil area recorded significantly higher yield (3.6 t/ha soybean and 2.5 t/ha of rabi sorghum) with recommended dose of fertilizer followed by recommended dose of N and K application to soybean (3.1 t/ha) and recommended dose of N and K to rabi sorghum (2.2 t/ha).
- ✱ In groundnut-rabi sorghum cropping system higher yield of groundnut was recorded with application of recommended dose of N, P & K (1.5 t/ha).
- ✱ In groundnut-tobacco cropping system, higher groundnut pod yield (2.2 t/ha) was recorded with recommended dose of fertilizer, followed by recommended dose of P (1.8 t/ha) and K (1.4 t/ha) respectively.
- ✱ Higher cotton yield was noticed with package of practices (1.9 t/ha) followed by farmer's practice with vermicompost application @ 2 t/ha (1.5 t/ha) as compared to farmers practice (1.2 t/ha) under rainfed conditions.

Tamil Nadu

Coimbatore

- Beetroot – greengram – maize + cowpea and Cotton - maize – sunflower are better alternate cropping systems to the existing Cotton - sorghum – finger millet for the Western zone. Compared to the existing cropping system, Beetroot – greengram – maize + cowpea gave an additional net return of Rs. 44,882/ha and cotton + greengram - maize - sunflower gave Rs. 43,110/ha.
- Chilli - onion and turmeric + onion and groundnut-sorghum, recorded > 20% increase in net returns with organic nutrient input system compared to inorganic system.
- An increase of > 20% organic carbon in soils was observed with turmeric + onion over a period six years. The increase in organic carbon content of soil was found to be up to 10% for all the other cropping systems experimented.
- Application of farm yard manure + non-edible oil cakes, each to meet half the N requirement in rice- black gram – *Sesame* and maize – sunflower systems have recorded higher increase in yield, net returns (247.4%) and organic carbon content (60%).
- Incorporation of enriched compost + vermicompost + green leaf manure (each to meet 3/8 the N requirement) recorded higher yield and net returns in groundnut-sorghum, soybean –wheat and chilli-cotton-onion systems. Higher increase in organic carbon content of soil was observed with farm yard manure (3/4) + green leaf manure (1/4) applications.

Thanjavur

- Rice - rice - brinjal and DS rice – rice – maize + black gram are the best alternate cropping systems to the existing Rice – rice – sesamum for the CNDZ

Paiyur

- Application of N, P and K @ 150:50:50 + Zn (25 kg/ha) recorded higher yield of 7.3 t/ha.
- Rice - Tomato cropping system is the most productive, remunerative and alternative cropping system for rice - rice system for North Western Zone.
- Cultivation of hybrid rice (27 P 63) gave higher yield of 16.5 t/ha over the ruling variety (BPT 5204).

Chettinad

- Balanced application of N, P and K @ 150:50:50 kg/ha with Zn @ 25 kg/ha registered significant higher grain yield of 6.1 t/ha.
- Rice-black gram cropping system is the most productive, remunerative and alternative cropping system for rice - rice system for Southern Zone of TN.
- Adoption of SRI technique resulted in higher yield of 6.6 t/ha.

Kerala

Karamana

- For attaining highest productivity 50 % nutrient must be substituted as organics during first crop season and entire nutrient as fertilizers during second crop season.
- The combination of nutrient entirely as fertilizers during first and second crop season revealed that a reduction of 50 % was detrimental for crop productivity.
- Though phosphorus is not generally a limiting nutrient in the acid soils of India, skipping of P fertilization for more than five years affects rice yields even under sufficient levels of nitrogen application and also affects crop response to N and K.
- Increase in P up to the third level was found to stimulate growth and tiller production.
- Withholding phosphorus also increases days to flowering and days to maturity of the rice crop by about two weeks
- P levels showed positive influence on the uptake of N and K by both grain and straw.
- By the end of 8th year, rice yield was highest under integrated nutrient management
- Highest cucumber yield of 24 t/ha was obtained with integrated nutrient management which was appreciably higher than all the treatments.
- Even with two crops, a rice equivalent as high as 20 t/ha/year is obtainable in the coastal wetland ecosystem with INM.
- In intensive rice based high value cropping systems under organic farming, yield is not stable over consecutive years
- Higher rate of N application was converted into economic yield in hybrid rice which gave a system productivity of up to 12 t/ha/annum, while with the local high yielding variety, Uma, the maximum system productivity attained was only up to 10.5 t/ha/annum.

Thiruvalla

- Fertilizer requirement can be reduced to 25 % during rabi season rice by substitution of 25 % RDN as organics during kharif. Continuous skipping of phosphorus reduced the rice yield and delayed maturity causing significant economic loss.
- In crop diversification, rice-rice-amaranthus gave higher returns in periurban area.

DIRECTORATE OF WATER MANAGEMENT, BHUBANESWAR

Salient Achievements

AICRP ON WATER MANAGEMENT

- At Bhavanisagar, drip irrigation of 1.50 m lateral spacing with 4 lph drippers at 60 cm in combination with 100% of recommended N and K fertigation was found to be suitable to sugarcane, banana, turmeric, tapioca and tomato.
- At Bhavanisagar, in aggregatum onion irrigating the crop at 1.2 IW/CPE ratio and inclusion of 1.00 kg B with recommended NPK fertilizer (60:60:30 kg NPK/ha) accounted for higher yield and B: C ratio.
- At Madurai, in sandy loam soils, rice irrigated through drip + azophosmet + Humic acid application recorded comparable yield with surface irrigation along with recommended dose of fertilizer.
- For sustainable yield of maize-chickpea in Malaprabha Command at Belvatagi (Karnataka) irrigation at IW/CPE of 0.8 was found better. It gave a higher maize grain yield of 7.89 t/ha, gross income (Rs. 63,177/ha), net income (Rs. 45, 427/ha) and B:C ratio (3.21).
- Drip-fertigation schedule and suitable crop geometry for Bt-cotton were standardized for Tamil Nadu. Drip-fertigation schedule for mechanised sugarcane, hybrid maize, banana with and without intercropping, chilli, brinjal and onion cultivation were also standardised.
- Water management practices for System of Rice Intensification (SRI) and Drum Seeding Techniques (DST) were standardized.

AICRP ON GROUNDWATER UTILIZATION

- In hard rock areas of the Parambikulam Aliyar Project basin in Tamil Nadu groundwater recharge rate varied between 3.39 to 21.61 % of annual rainfall with an average of 10.94 %. The recharge rate due to North-East monsoon is better than South West monsoon. The present recharge contribution rate is not sufficient for sustainability of groundwater resources in the basin.
- Groundwater quality for irrigation in PAP basin of Tamil Nadu was assessed. As per the USSL classification, most of the samples come under high salinity class (C3), followed by very high salinity class (C4) and medium salinity class (C2). The most dominant cation was Na followed by Mg, Ca and K. Chloride domination was clear, followed by bicarbonate, carbonate and sulphate. Magnesium dominated water types were observed in majority of the places. Salinity persists in groundwater of the basin. Though sodicity is observed, there is no associated permeability hazard. Contents of heavy metals in groundwater samples were within the critical limits.

AICRP ON SOIL TEST CROP RESPONSE CORRELATION

Achievements

Karnataka

- Forty eight STCR fertilizer prescription equations were developed for different crops and cropping systems of different Agro Climatic Zones of Karnataka through Integrated plant nutrient supply (IPNS) approach.
- Three cropping sequence equations were developed for paddy-ragi sequence in Zone-6 (Southern dry zone) and adopted prediction equation for soil test values and compared with actual values and used these values for next sequence

- IPNS Fertilizer adjustment equations are being developed and so far 8 IPNS equations were developed for paddy, ragi, dry land ragi, hybrid maize, sugarcane, onion, carrot and brinjal
- Eighty verification trials were conducted at different agro-climatic zones of Karnataka on hybrid maize, ragi, groundnut, cabbage, soybean, sugarcane, bhendi, sunflower, paddy, aerobic paddy and chilli to confirm the results obtained from experiments. Fifty large scale front line demonstrations were conducted in farmers' fields, mainly on oilseed crops. Increase in average response to STCR approach over farmer's practice in q/acre for different crops were: Maize - 3.39 to 15.50; Groundnut - 0.99 to 3.81; Sunflower - 2.94 – 5.70; Sugarcane - 132.8 to 364.4; Safflower - 1.48 to 3.52; Ragi - 2.93 to 12.80; Ragi - 3.74 to 6.28; Paddy - 4.99 to 5.14; Soybean - 1.43 - 2.23 and Cabbage - 24.41 to 31.70. Value Cost Ratio (VCR) worked out under verification and FLD's are: Ragi: 1.92 - 16.25; Paddy: 2.01 -- 19.37; Aerobic (Paddy): 22.5, Sunflower: 1.38 - 13.60, Groundnut: 4.50 - 16.62, Maize (Hybrid): 1.78 - 13.62; Safflower: 2.20- 2.71; Sugarcane: 19.30 - 32.80; Soybean: 2.88; Cabbage: 6.61 - 9.09.

Kerala

- Targeted yield prescription equations were developed for 18 crops viz., Nendran banana, ginger, rice, turmeric, sweet potato, ash gourd, coleus, Groundnut, Cucumber (Oriental pickling melon), bitter gourd, amaranthus, bhendi, snake gourd, brinjal normal, brinjal ratoon, chilly, pumpkin, water melon.
- Development fertilizer adjustment equations under integrated plant nutrient supply system were developed for 10 crops viz., Ginger, Turmeric, Rice, Sweet Potato, Ash gourd, Coleus, Groundnut, Cumber (Oriental pickling melon), Amaranthus, Water melon.
- Multi-location/verification follow up trials (45) were conducted to confirm the results obtained from experiments. Front line demonstrations (20) were conducted in farmers' fields also. STCR technology was found to be superior to farmers' practice.

Tamil Nadu

- Forty two STCR fertilizer prescription equations were developed for 24 agricultural/horticultural crops on 12 soil series in six Agro Climatic Zones of Tamil Nadu.
- Cropping sequence equations were developed in maize-cotton, sorghum – cotton, ragi – sorghum, rice-groundnut-pulse, rice-rice-pulse, cotton-maize and sunflower-bhendi in western Zone, and rice-rice-pulse in southern zone and adopted prediction equation for soil test values
- IPNS Fertilizer adjustment equations were developed for 20 crops viz., rice (on five soil series), wheat (hills & plains), sorghum, maize, ragi, groundnut, sunflower, sugarcane, cotton, onion, bhendi, cabbage, cauliflower, potato, carrot, beetroot, radish, tapioca, turmeric and ashwagandha.
- Verification trials (296) were conducted at different Agroclimatic zones of Tamil Nadu on rice, wheat (hills & plains), sorghum, maize, ragi, greengram, blackgram, groundnut, sunflower, gingelly, sugarcane, cotton, onion, bhendi, cabbage, cauliflower, potato, carrot, beetroot, radish, tapioca, chilli, turmeric and ashwagandha to confirm the results obtained from experiments and 90 large scale FLDs were conducted.

Reassessment and delineation of micro and secondary nutrient deficient or toxic areas and updating soil fertility maps.

- Coimbatore centre of AICRP-MSPE collected village-wise soil samples at 0 -15 cm depth along with GPS coordinates covering all the blocks in the districts of Cuddalore, Krishnagiri and Viliupuram. The samples were analysed for available micronutrients such as Zn, Fe, Cu, Mn and B and the soil samples were grouped as deficient or sufficient based on the critical limits fixed for the soils. Thematic maps showing status of different available micro nutrients were generated at block level for each district.

Percentage of micronutrient deficiency in soil

Name of the district	Zn	Fe	Mn	Cu	B
Cuddalore	49.9	4.2	0.6	32.6	4.8
Krishnagiri	53.6	16.6	7.2	16.6	21.2
Villupuram	76.3	18.5	34.0	42.6	1.0

The results in general showed that the Zn deficiency is the most prevalent in all the three districts (49.9 to 76.3 %) followed by Cu (16.6 to 42.6 %), Fe (4.2 to 18.5), Mn (0.6 to 34.0.%) and B (1.0 to 21.2 %).

Role of organic manures, green manures and sewage sludge in correcting micro and secondary-nutrient deficiencies

IPNS technology involving combined application of FYM at 12.5 t/ha with ZnSO₄ at 37.5 kg/ha to the main crop (kharif) alone had performed better in increasing cumulative rice productivity to 28,672 kg/ha (grain + straw of two season) in rice-rice cropping system in a zinc deficient soil (Typic Haplusterts). Besides improving soil fertility status, a saving of 12.5 kg ZnSO₄ was observed by adoption of the above IPNS technology for rice- rice cropping system as a whole, instead of applying 25 kg ZnSO₄/ha for each crop.

ALL INDIA NETWORK PROJECT ON SOIL BIODIVERSITY /BIOFERTILIZERS

Centres: TNAU, Coimbatore and UAS, Dharwad.

Salient achievements:

Organic Farming

- At Coimbatore, in a 100 year old permanent manorial trial, organic manured soil had higher organic matter, nitrogen, total bacteria, fungi and nitrogen fixers than the one in which only chemical inputs (100% NPK) were added. Soil enzymes were significantly higher inorganic than chemically fertilized soils. The physico-chemical and nutrient status of the soil was not dramatically changed due to long-term influence.
- In genomic analysis of organic and chemically fertilized soybean and maize soils in Karnataka, diverse species were seen and some were unique to organic treatment. The pattern of nitrogen fixing genes was not related to the treatment. Ammonification genes were mainly present in chemically fertilized soils. Among mycorrhizal fungi, *Glomus* was found to be most common.

This information will help to identify presence / absence of beneficial microorganisms or their products in particular soil. Further, refined analysis of these specific genes will give relative abundance of these organisms / their products and help to identify parameters that can be used as soil health indicators.

Bioinoculants for rice: Bioinoculants for nursery seed bed of aerobic rice (SRI method of rice cultivation) were evaluated at Coimbatore. In the field, application of 125% NP and 100 % K fertilizers along with seed treatment of *Azospirillum* and phosphobacteria recorded maximum grain yield increase (40%) over 100 % NPK control. Likewise, application of-concentrated AM fungi along with *Azospirillum* bioinoculant in seed bed of SRI nursery with 100 % NPK fertilizer recorded 21% increased grain yield over fertilizer control.

Front Line Demonstrations in Tamil Nadu: FLDs conducted in farmers’ fields showed 13 - 31% yield increase due to rhizobial inoculation in groundnut and 13 % increase in rice due to Azophos application. Field days were conducted to demonstrate and to create awareness about biofertilizers usage for groundnut and pulses.

AICRP ON AGROFORESTRY

TNAU Mettupalayam

- In the *Pongamia pinnata* based silvipasture system, a significant reduction in the plant height and yield of the fodder crops was observed due to the shade effect of trees. Among the six fodder crops, maximum in the plant height and fodder yield was observed in *Desmanthus* and least in guinea grass followed by *Cenchrus* when compared to pure crops. The green fodder yield of fodder sorghum, *Cenchrus*, guinea grass, *Desmanthus*, *Stylosanthes* and lucerne was 18450 kg/ha, 3876 kg/ha, 3906 kg/ha, 1500 kg/ha, 750 kg/ha and 440 kg/ha respectively.
- Growth and yield of cowpea was reduced under the tree compared to sole crop. Among the tree species, maximum reduction in the grain and stover yield of cowpea was observed under eucalyptus. After seven years of intercropping under different tree species, there was a slight decrease in.

TANUVAS, Kattupakkam

- A sixty days lactation trial was conducted in cross bred dairy cows to study the effect of subabul feeding on milk yield and its composition. It has concluded that subabul can safely replace 20% of green fodder (DMB) in lactating crossbred cows without affecting milk yield and its composition.
- Feeding trial was conducted in weaned lambs (6-months old) with chemically processed *Jatropha* oilcake revealed that *Jatropha* oil cake can be included in goat ration up to 7.5 per cent level.

UAS, Dharwad

- In teak based legume cropping system, grain yield of soybean with teak was higher as compared to teak with other legumes. Teak growth was significantly higher with soybean / greengram as compared to with red gram.
- Investigations on density levels in DBH of *Melia azadirach* and yield of soybean and net returns were significantly higher in 5 x 4 m spacing as compared to other spacings tried.
- Among the tamarind collections, growth of NTI-77, SMG-13 and NTI-5 provenances were significantly higher and fruit yield was higher in SMG-13 and NTI-14 as compared to other provenances.
- In a study on tamarind – curry leaf based agroforestry system, growth of tamarind clone V-2 and B-1 were superior than others. Curry leaf yield was higher with tamarind clone V-2 and TH as compared to other clones.

KAU, Thrissur

Teak (*Tectona grandis*) and *Acacia mangium* are the two mandatory species allotted to the centre. Ten years of results indicate that Nilambur provenances of teak and Papua New Guinean provenance of *A. mangium* (Balimo and Arufi Village) performed better in growth. A promising MPT-based black pepper production system involving high density block plantation of *Acacia auriculiformis* and *Artocarpus heterophyllus* as support trees has been developed. Better performing tree-fodder grass combinations were *Casuarina equisetifolia* hybrid Napier and *Ailanthus triphysa*- guinea grass. Ginger has been successfully integrated as an intercrop in thinned *Acacia mangium* plantations.

AICRP ON MANAGEMENT OF SALT AFFECTED SOILS AND USE OF SALINE WATER IN AGRICULTURE

Tiruchirapalli Centre, Tamil Nadu

1. Survey and characterisation of ground water quality in Namakkal district of Tamil Nadu was carried. Among 182 samples 61%, 29% and 10% samples showed electrical conductivity less than 2, 2 to 4 and 4 to 6, respectively. The RSC of the samples ranged from 0 to 5.2 and SAR from 0.31 to 9.8.
2. Field experiment on conjunctive use of canal and alkali water in rice based cropping system was conducted. Results revealed that canal water irrigation for rice recorded the maximum yield of 6.5 t/ha followed by cyclic irrigation of canal and alkali water in 1:1 ratio. In respect of planting method, square planting in rice crop registered the maximum grain yield followed by line and machine planting. Application of canal water and alkali water in 1:1 ratio in cyclic mode with square planting recorded 34.9% more yield than the alkali water irrigation with conventional planting.
3. Drip irrigation using spent wash treated water recorded highest yield in okra and drip irrigation of gypsum bed treated water recorded highest yield in cluster bean.
4. Green gram varieties like VBN2, CO6 and CO7 and maize variety CO1 and hybrids viz. COHM5, C818 were tested for their sodicity tolerance. Gram variety CO6 and maize hybrid C818 recorded maximum yield at ESP 9.5.

Gangawati Centre, Karnataka

1. Survey and characterization of ground irrigation water quality of Gadag district, Karnataka was carried out. More than 75% of the ground water in the district is non-saline; however in majority of samples Mg/Ca and Cl/SO₄ ratios exceeded 0.63 and 2.0, respectively which are reported to be critical for causing Mg hazard and Cl injury in sensitive crops. About 14% of samples each in Gadag and Mundaragi taluks were of highly alkali (SAR > 10 and RSC > 4.0 meq/l). About 40% of samples from Gadag district were found to be problematic (saline, high SAR saline and alkali) requiring special attention.
2. Significantly higher cabbage yield of 18.11 t/ha was obtained under drip irrigation with ET level of 1.2 followed by 1.4 ET (17.81 t/ha), 1.0 ET (16.43 t/ha), and 0.8 ET (14.72 t/ha). Highest water use efficiency (WUE) of 66.9 kg/ha-mm and 57.2 kg/ha-mm was obtained with drip irrigation level at 0.6 ET and surface irrigation in 0.8 ET, respectively.
3. Application of FYM @ 10t/ha with 50% of gypsum requirement recorded significantly higher seed yield of sunflower (18.17 q/ha) which was on par with application of vermicompost @ 2.5 t/ha with 50% & 75% of gypsum requirement (16.84 & 17.18 q/ha, respectively). Similarly higher kapas (cotton) yield recorded with application of FYM @ 10 t/ha with 75% of gypsum requirement which was remained on par with the application of vermicompost @ 2.5 t/ha with 50% & 75% of gypsum requirement (15.22 & 16.10 q/ha, respectively).
4. In the scenario of shortage of water to sustain existing paddy-paddy cropping sequence and also problem of waterlogging and salinity especially in low-lying areas, more economic crops/cropping sequence are required to be established to convince the farmers to shift from paddy to other low water requiring crops.

DIRECTORATE OF WEED SCIENCE RESEARCH

TNAU, Coimbatore

- New invasion of quarantine weed: *Solanum carolinense* L., (Horse nettle) has been observed in many parts of Tamil Nadu, particularly under non-crop situations.
- Under System of Rice Intensification (SRI), application of pyrazosulfuron ethyl at 30 g/ha on 3 DAT with rotary or cono-weeder on 40 DAT was recommended.
- In maize, pre-emergence application of atrazine 0.5 kg/ha or oxyflurofen 0.2 kg/ha on 3 DAS + Twin wheel hoe weeding on 45 DAS for higher grain yield and economic returns.
- In transplanted rice-rice cropping system, integrated weed control by butachlor 0.75 kg/ha on 3 DAT + 2,4-DEE 0.40 kg/ha on 15 DAT followed by pretilachlor 0.75 kg/ha on 3 DAT + 2,4-DEE 0.40 kg/ha on 15 DAT with 75% inorganic + 25% organic nitrogen recorded maximum yield.
- For *Orobanche* control, pre-emergence application of pendimethalin 1.0 kg/ha or pre-plant incorporation of fluchloralin 1.0 kg/ha and plant hole application of neem cake 200 kg/ha reduced *Orobanche* shoots with higher control efficiency and tobacco leaf yield.
- *Management of Striga asiatica* in planted sugarcane: pre-emergence application of atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP with an earthing up on 60 DAP combined with POE 2,4-D Na salt 5 g/l (0.5%) + urea 20 g/l (2%) on 90 DAP + mulching with cane trash @ 5 t/ha after final intercultivation on 120 DAP controlled of *Striga asiatica* under red sandy loam soils.
- Secondary metabolites of atrazine viz., hydroxyatrazine in maize grown soil and ethofumesate viz., oxy-ethofumesate and hydroxyl ethofumesate in sugar beet grown soil were identified using GC-MS.

UAS, Bengaluru

- During survey, new weeds *Solanum carolinense* and *Solanum sisymbriifolium* were noticed in wasteland and near garbage areas.
- In rice-rice cropping system, pretilachlor 0.75 kg/ha at 3 DAP during kharif was recommended.
- In maize-groundnut cropping system, use of atrazine 1.0 kg/ha as PE followed by one mechanical weeding at 3 WAS in maize and use of pendimethalin 1.0 kg/ha at 3 DAS in groundnut were found to be the most economical weed control practice.
- For *Orobanche* control in tomato- potato- brinjal based system, use of herbicides, oxyfluorfen 0.1 kg/ha, pendimethalin 0.75 kg/ha and metribuzin 0.5 kg/ha at 3 DAP delayed the emergence by 10-15 days and lowered the *Orobanche*. Use of neem cake 200 kg/ha in rows lowered the menace by 40%.
- Composts or green manure of *Chromolaena odorata*, *Cassia uniflora* and *Parthenium* contained nutrients similar to FYM and green manure crops.
- In direct seeded rice, pretilachlor + safener 30 EC 0.75 kg/ha at 3 DAS, cyhalofop butyl 10 EC at 90 g/ha + (chlorimuron ethyl + metsulfuron methyl) 20 WP at 4 g/ha, fenoxaprop 9 EC at 60 g/ha + (chlorimuron ethyl + metsulfuron methyl) 20 WP – 4 g/ha at 25 DAS, bispyribac sodium 10% SC 25 g/ha at 20 DAS and Fenoxaprop 9 EC at 60 g/ha + Ethoxysulfuron 15 WG at 15 g/ha at 25 DAS gave similar yield as that of hand weeding (20 & 45 DAS).

UAS, Dharwad

- During survey *Eleutharanthera ruderalis* was found underneath trees, on road / roadsides and on bunds.
- In sugarcane ratoon results revealed that atrazine 2.0 kg/ha pre-emergence on 3 DAH + 2,4-D 1.25 kg/ha post- emergence on 90 DAH + directed spray of glyphosate 1.0 kg/ha on 150 DAH produced highest cane yield.
- In maize-chickpea cropping system, application of atrazine in maize and alachlor 1.5 kg/ha in chickpea were recommended.
- Integrated weed management in groundnut-wheat cropping system: In groundnut, application of alachlor or pretilachlor @ 1.5 kg/ha integrated with intercultivations and hand weeding was found effective whereas, in wheat, application of metsulfuron methyl 4 g/ha significantly reduced weed population and resulted in higher yield.
- Management of *Cuscuta* in onion: Application of pendimethalin 1.0 kg/ha PE as sand mix reduced the density of *Cuscuta*.

KAU, Thrissur

- Zero tillage can be successfully practiced in rice. However, there is a shift from common weeds to *Eleocharis*, a perennial sedge. Penoxsulam and Azimsulfuron were effective in controlling broad spectrum of weeds in rice whereas fenoxaprop ethyl was effective in controlling grass weeds in rice. Stale seed bed for 14 days resulted in reduced weed problems in rice.
- In semi dry rice, stale seed bed for 14 days with shallow hoeing at 7th and 14th day reduced the weed problem. Growing cowpea as intercrop for 30 days reduced the weed intensity.
- In ginger, application of glyphosate 10 ml/l before emergence of ginger shoots (at about 30 DAP) was effective in controlling the early emerging weeds. Pre-emergence application of oxyfluorfen 0.2 kg/ha and diuron 1.0 kg/ha were effective in controlling weeds.
- Coconut, arecanut and rubber plantations: Round up 8 ml/l was effective.
- *Ipomoea cornea*: Round up 15 - 20ml/l spraying was effective.
- Weed competitive rice varieties: C3-2-49 and Jyothi were most competitive varieties.

AICRP ON DRY LAND AGRICULTURE

The AICRPDA network has 2 centers in Karnataka (UAS Bangalore at Bangalore and UAS Dharwad at Bijapur) and one center in Tamil Nadu (TNAU, Coimbatore at Kovilpatti). All the three locations have semi-arid climate. Bangalore has alfisols; Bijapur has vertisols; while Kovilpatti has vertic inceptisols.

Karnataka

Bijapur

- Application of pebble mulch was superior over sand mulch for reducing soil loss and runoff. Higher sunflower equivalent yield was recorded in the pebble mulch plot.
- Conventional tillage along with sunnhemp incorporation @ 5 t/ha has given highest rabi sorghum grain yield of 604 kg/ha
- In pigeon pea, planting geometry of 135 cm x 20 cm was superior and gave significantly higher yield of 1602 kg/ha.
- Horse gram variety 'BIJ-Local' gave better response for seed yield with increased spacing and fertilizer in both deep black and shallow soils, while PHG-9 gave under shallow soils.

- Under integrated farming systems, the net income from different components viz. crops, horticulture, goat and poultry was Rs.17404, Rs.2643, Rs. 25307/- and Rs.6200/- respectively with overall income of Rs. 51656/ha. The farming system studies were carried out on an area of one hectare with different components.

Bangalore

- Giant bajra was superior for forage with higher green forage yield of 63086 kg/ha.
- 'Bellary red' variety of onion was superior for bulb yield (4318 kg/ha).
- Application of FYM @ 10 t/ha + 100 % NPK was superior and gave significantly higher groundnut pod yield of 965 kg/ha. Similarly, FYM @ 10 t/ha + 100 % NPK gave significantly higher grain yield of 3499 kg/ha under mono-cropping of finger millet.
- Application of recommended N & K₂O (50:40 kg/ha) + Lime @ 300 kg/ha + MgCO₃ @ 150 kg/ha + Borax @ 10 kg/ha recorded significantly higher finger millet grain yield of 3748 kg/ha.
- Intercropping of castor + finger millet (1:2) gave significantly higher castor equivalent yield of 1709 kg/ha.
- The variety 'Samrudhi' of chilli gave highest green chill yield of 10.41 t/ha.

Bangalore (Operational Research Project)

- Opening of moisture conservation furrows between paired rows of pigeon pea in finger millet + pigeon pea (8:2) produced higher finger millet grain equivalent yield of 5481 kg/ha and net returns of Rs. 40312/ha with BC ratio 3.78 compared to farmers' practice (BC ratio 1.97).
- Application of micro nutrients and bio-fertilizers along with RDF recorded higher pod equivalent yield of 1876 kg/ha with BC' ratio of 2.86 compared to farmer' practice (BC ratio 1.95) in groundnut + pigeon pea (8:2) system.
- Among different finger millet based cropping systems, growing of finger millet + pigeon pea (8:2) gave finger millet grain equivalent yield of 5198 kg/ha with BC ratio of 3.59 compared to farmers' practice (BC ratio 1.99).
- Among different groundnut based cropping systems, groundnut + pigeon pea (8:2) and opening moisture conservation furrow between paired rows of pigeon pea gave higher pod equivalent yield of 1653 kg/ha with BC ratio 2.72 compared to farmers; practice (BC ratio 1.97).
- Improved varieties of finger millet produced higher yield (2644 to 4056 kg/ha) compared to local varieties (1650 kg/ha). Among long duration varieties, L-5 gave higher grain yield of 4056 kg/ha compared to MR-1 (3800 kg/ha). GPU-66 recorded higher grain yield of 3311 kg/ha compared to ML-365 (3244 kg/ha). Under medium duration, GPU-48 recorded grain yield of 2644 kg/ha.

Tamil Nadu - Kovilpatti

- Maximum Bt cotton (Tulasi) yield of 890 kg/ha was obtained by application of urea (80 kg N/ha) + DAP (40 kg P₂O₅/ha) + muriate of potash + ZnSO₄ @ 25 kg/ha.
- Maximum maize (900M Gold) yield of 3340 kg/ha was attained with application of urea (40 kg N/ha) + DAP (20 kg P₂O₅/ha) + muriate of potash (20 kg K₂O/ha) + ZnSO₄ @25 kg/ha.
- Under integrated farming systems, cropping + dairy + goat components gave monetary returns of Rs. 58277/ha compared to Rs. 11125/ha under cropping component only. The improved farming system gave the employment round the year.

NBSS & LUP, REGIONAL CENTRE, BANGALORE

Achievements for the period 2010 & 2011

Land resource inventory for farm planning in different agro-ecological regions of India: This pilot project was taken up covering 16,873 ha in Chikarsinakere Hobli, Mandya dist., Karnataka. About 700 profiles were studied and 13 soil series were identified. Out of this, 8 series occur in the uplands, one in the middle lands and 4 in the lowland areas of the block. Village wise soil maps were finalized with 118 mapping units.

Development of software modules for land evaluation and agro-climatic analysis: Software for drought analysis and probability of occurrence of moderate and severe drought in an area was developed using the method described by IMD.

Geomorphological analysis and landform-soils-landscape relationship in Southern India

Landforms of Karnataka

- Generalized landform assemblages were delineated from the available information such as the geology and physiographic maps.
- The major geomorphic processes that are identified in the granite – gneissic complex are weathering processes that are attributed to the influence of vegetation and biological activity along with block disintegration.
- A simplified model has been developed for easy mapping of soils at village level based on the available geomorphic processes and their influences.

Agro-ecological zoning of Tamil Nadu

- 17 Agro ecological zones were delineated considering landform, rainfall and major soils.
- LGP assessed by NBSS sent for validation to research stations of TNAU spread over state.
- Soil management units were delineated within the zone.

Development of district level land use plan for Mysore district, Karnataka state

- Mysore is predominantly an agrarian district with geographical area 676,382 ha. District has been divided into 12 Land Management Units (LMUs) by spatial integration of external land features, soils, agro-ecology and land use and production systems. Each LMU was evaluated for their potentials and limitations.
- Socio-economic and crop production data was collected from 342 farmers covering major soils, production systems and all categories of farmers and same has been linked to LMUs.
- Land suitability for tobacco was prepared, considering its viable location and further scope for expansion.
- Multiple goal linear programming (MGLP) was used as model to optimize the options with a set of given constraints for agricultural development in a district.
- Identification of prime agricultural lands with the combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops to produce relatively high yields of crops with economical returns if cultivated and managed according to acceptable farming methods.
- Preparation of prospective land use plan for Mysore district is in progress.

Assessment of stakeholder needs and economic evaluation of land use types for land use planning of Mysore District

- The land use pattern reveals that area under forests remained constant over one decade.

- The projected cropping patterns shows that by 2024-25 there will be an increase in area under rice, maize, green gram, sugarcane and fruit crops.
- The decline in area was observed in ragi, jowar, redgram and mulberry crops. It is projected that there will be huge shortage of cereals, millets and oils.
- Production in pulses, sugar, fruits and vegetables will be surplus by 2024-25.

Land resource inventory and GIS database for farm planning in 10 blocks of Tamil Nadu

- This project was taken up in 10 blocks of the state in 2008 and field work was completed during 2008 to 2009. Finalization of the maps and preparation of reports is in progress

Soils of Thirupuram, Kanjiramkulam and Kadinanamkkulam Panchayats of Thiruvananthapuram district, Kerala

- Detailed soil resource inventory of three panchayats of Thiruvananthapuram district viz., Thirupuram, Kanjiramkulam and Kadinamkulam (3415 ha) was carried out and four soil series namely Neyyattinkara, Kanjiramkulam, Poovar series and Kadinamkulam were identified.
- The spatial distribution of the soils has been delineated in the panchayats as phases of the soil series were mapped.
- Soil fertility study revealed that soil reaction varied from strongly acid to neutral.
- Plant available nitrogen were deficient in >70 % samples. Plant available phosphorus were found to be adequate in > 75% samples. About seventy five per cent samples were deficient in potassium.
- Deficiency of micro-nutrients, copper, zinc is widespread. Boron was deficient in few samples. Manganese was found to be deficient in many samples

Recommendations

- Liming of acid soils is essential to correct the unfavourable soil reaction. This can not only ensure adequate supply of calcium, but also improve availability of applied fertilizers.
- Regular application of fertilizers containing macro-nutrients (N, P and K) is necessary to enhance crop productivity.
- Micro-nutrient deficiencies have to be corrected through their application either as soil or foliar application.

Nutrient indexing and soil fertility assessment of Kole lands (Collaborative Project with KAU)

- The task of digital processing of spatial data sets collected, had been completed pertaining to 20 panchayats (out of 32) with Kole lands. One crop of rice is taken on these lands after flushing of the sea water by monsoon rains.

Land use planning for Tirumale sub-watershed (Motaganhalli watershed) in Magadi taluk, Ramangar district, Karnataka

- Geo-morphological analysis and extensive traversing was done to identify important land use types and land forms. 10 transects were identified and studied.

Major constraints in the watershed

- Considerable area is covered with rock outcrops and productivity levels of most crops are lower than the state average.
- Ground water level is below 200 meters and no efforts were observed for rain water harvesting and ground water recharge system.

- Systematic terracing not followed and weathered parent materials are exposed. They are very poor in fertility and quality.
- Labour scarcity is a serious limiting factor in adopting essential package of practices.
- Overgrazing by the cattle resulted in severe vegetal degradation.

Potentials and opportunities observed in the area

- Most of the cultivated terraces need strengthening of bunds to minimize the soil erosion.
- The soils of watershed are free from soil alkalinity, acidity, drainage.
- Deep soils occur even below rocky surfaces in certain places allowing good performance of tree crops like mango, jack fruits etc.
- Proximity to Bangalore and suitable climate provide bright scope for the cultivation of high value fruit and vegetable crops.
- Goat and sheep rearing is a most common enterprise and provides a good source of income. However stall feeding needs to be promoted to prevent the vegetal degradation.

Soil based plant nutrient management plan for agro-ecosystems of Kerala

- Development of soil based plant nutrient management plan for all the panchayats (1000), agro-ecological units (23), districts (14) and the state were initiated in collaboration with Kerala Government.

Agro-ecological units of Kerala

- Five agro-ecological zones and 23 agro-ecological units were finalized using FAO model and with local modifications.

Assessment of land resources for growing horticultural crops in selected districts for Tamil Nadu under the National Horticultural Mission project

- The suitability of soil and other land resources of 14 districts were assessed for the cultivation of horticultural crops based on the information generated by the Bureau. All 14 district reports were finalized and submitted to the Department of Agriculture, Tamil Nadu.

Delineation of potential areas for commercially important medicinal and aromatic plants in different Agro-ecological zones of Karnataka using GIS tools.

- Collected soil samples and plant samples of *Eucalyptus citriodora* from Chikkaballapur, Gudibunde and Bagepalli taluks.
- Four profiles were studied at Yellampalli, Beechiganahalli, Hadigere and Karohatti, where *E. citriodera* and amla plantations are grown, respectively.
- Soil analyses of 37 sampled sites have been completed for pH, EC, On, Available N, P, K and secondary and micronutrients.

CENTRAL SOIL AND WATER CONSERVATION RESEARCH & TRAINING INSTITUTE, RESEARCH CENTRE, UDHAGAMANDALAM

The Central Soil & Water Conservation Research & Training Institute (CSWCRTI), Research Centre, Udhagamandalam is engaged in fundamental and applied research, training and transfer of technology in the field of soil and water conservation and watershed management in the Western Ghats of the hilly high rainfall regions of Southern India.

Progress of research

Water erosion appraisal in different agro-ecological regions: Soil loss tolerance limit (SLTL) values were computed for different soil mapping units of Kerala and Tamil Nadu and their maps generated in GIS.

Conservation measures for sustainable production systems: Integrated nutrient management (INM) options have been developed for achieving higher soil productivity and conservation under the cultivation of export oriented vegetables like Brussels sprout, broccoli and lettuce in the Nilgiris.

Integrated management of soil health for sustainable production in the Nilgiris: INM treatment where recommended fertilizers and bio-fertilizers were applied with annual application of FYM (10 t/ha) and lime (5 t/ha) was found to be the best. Average runoff varied from 10.8 to 13.0 % of the total mean rainfall and average soil loss ranged between 3.58 to 4.64 t/ha.

Techniques for establishment of tea on terrace risers: Initial survival percentage of tea was highest (99%) in inward sloping terraces where planting was done in big holes with the application of fertilizers and FYM. Soil moisture was found to be significantly higher (26.0 to 28.3 %) during dry spell when tea is planted in bigger size pit with application of FYM and fertilizers.

Development of suitable land and crop management practices for the Nilgiris: Geranium is recommended as a good vegetative barrier in cultivated sloping lands for the formation of vegetative or Californian or Puerto Rican type of terraces. Cineraria and Geranium are recommended for growing on the terrace risers.

Effectiveness of different bio-engineering measures in new tea plantation in the Nilgiris: Contour Staggered Trenches (CST) with cover crop of beans produced least average runoff (13.2 %) in a new tea plantation followed by Contour Staggered Trenches (13.5 %) with maximum under lower slope range. Similar trend in runoff was observed in higher slope. Minimum soil loss was recorded in CST followed by CST with cover crop of beans.

Hydrological behaviour of watersheds for conservation planning: In Salaiyur watershed, the potential recharge volume from 13 water harvesting structures in this watershed varied between 0.1 to 1.0 % of the rainfall received over an average of 0.5%. The threshold rainfall needed to trigger 1 mm of recharge varied from 108.32 mm to 162.40 mm for the different water harvesting structures. The time lag for ground water recharge after a rainfall event was 5 days.

Rehabilitation of areas affected by mass erosion: : Detailed survey was conducted and thematic layers on geology and geomorphology, soils, land use, forest cover, slope and watershed boundaries for the Nilgiris have been created in GIS in order to characterize landslides.

Participatory integrated watershed management: Participatory Integrated Watershed Management approach is being demonstrated by developing a model watershed at Ayalur. As a result of water harvesting measures a total of 200 ha-cm water has been harvested during 2010 and the impact on ground water recharge was visualized by a rise in ground water table ranging from 3.4 to 13.9 m in the vicinity of the structures.

Development of Model Watershed – Iduhatti in the Nilgiris: With funding support from Hill Area Development Programme, technological interventions like construction of water harvesting structures, collection wells, introduction of improved tea clones, soil and water conservation measures in tea plantations, crop demonstrations, income generating activities for resource poor and horticulture plants in homestead garden have been taken up in the watershed using participatory Integrated Watershed Management approach.

Socio-economic analysis and policy development for watershed management: The Cobb-Douglas production function analysis showed that > 90 per cent of the variations in the soil and water conservation outputs were explained by the explanatory variables in the model for all the soil and water conservation measures included in the sample. Among the explanatory variables,

marketing infrastructure has positive and significant influences on the soil and water conservation measures.

Human resource development and technology transfer: Constraint analysis was conducted in two selected watersheds of Tamil Nadu. At field level, most of the farmers have expressed that lack of capital, high cost of inputs and fragmented land holdings were the major constraints in adoption of SWC technologies. The field staff told that emphasis should be given to technology transfer rather than target oriented activities. The group methods are effective in transfer of SWC technologies than mass and individual methods.

Impact of technology developed vs. their adoption level

Technology transfer through FPAR Programme: Twelve demonstrations were conducted on four technology packages covering soil and water conservation measures, Integrated Plant Nutrient Supply (IPNS), micro irrigation, and water harvesting in the Nilgiris district of Tamil Nadu. These technologies were demonstrated in 14 villages covering 32 farmers. Due to improved crop varieties and IPNS practices, there was 37.2 % increase in yield and 41% increase in WUE in case of rainfed vegetable crop cultivation in a moderately sloping land. The yield increase was to the tune of 23.5 and 15.9% in rainfed potato and carrot respectively due to IPNS on moderately outward sloping terraces. The increase in yield ranged from 4.8 to 34.1% for different vegetables due to micro irrigation and IPNS in case of Irrigated vegetable on flat land. The increase in WUE for different vegetables ranged from 4.8 to 74.8 due to micro irrigation + INM.

Technology transfer through ToT Programme: Demonstration on INM for different crops in bench terraces shows that there was an increase in yield in the tune of 10, 15 and 16 % in potato, carrot and cabbage respectively.

Training: The Research Centre organised 62 Short courses for Gazetted and Non-Gazetted Officers.

CENTRAL SOIL & WATER CONSERVATION RESEARCH & TRAINING INSTITUTE, RESEARCH CENTRE, BELLARY

The Central Soil & Water Conservation Research & Training Institute, Research Centre, Bellary was established in 1954 to identify the erosion problems of black soils of the semi-arid region and develop technical solutions to the problems of land degradation and restore productivity on a sustained basis.

Salient research achievements during 2010 and 2011

Erosion productivity relationships for evaluating vulnerability and resiliency of soils under different agro- climatic regions of India: Initial results revealed that runoff and soil loss increased with increase in slope from 0.5% to 2.0% in both sorghum and bengalgram crops. Minimum soil loss and runoff was recorded in control in all three slopes. Less runoff occurred in bengalgram with 0.5% slope as compared to sorghum crop as bengalgram crop provided good ground cover till harvest.

Evaluation of fruit species vis-à-vis conservation techniques for salt affected black soils of semi-arid tropical regions: The growth of amla, ber and sapota during 2008-09 was better under conservation measures than farmer practice (control). Salt affected rainfed vertisols in the dry zones are not suitable for growing amla. Even the performance of ber and sapota is not very satisfactory and there is an urgent need to identify lesser known hardy fruit types for the utilization of such lands in the dry zones.

Effect of conservation structures on ground water recharge: Annual rainfall data from 1985 to 2003 (19 years) revealed that the average rainfall was 575 mm and runoff-producing rainfall was 357 mm (62 % of total rainfall). Analysis of rainfall and run off trends clearly indicated that effect of conservation measures are responsible for decrease in runoff and increase in watershed storage which in turn helped to increase ground water recharge.

Resource Conservation and Management in Netranahalli Watershed, Chitradurga District, Karnataka

Scientific land use planning for natural resource conservation is being implemented in a watershed spread over 479 ha. During this period the following interventions were carried out.

- a) **Crop Demonstrations** for important crops of the region, to expose farmers to improved varieties which could be adopted by them.
- b) **Forestry and dry land horticulture development:** Under dry land horticultural development 45.3 ha area has been covered. Grass sodding on graded bunds (300 m) with different grass species such as hybrid Napier, guinea grass and *B. decumbens* has been done. Afforestation was carried out in the main drainage nala by planting *Gliricidia*, teak, silver oak and TBOs like *Pongamia pinnata* and *Simarouba glauca* seedlings all along the *nala* in the upper reach of watershed to reduce the soil loss and also to strengthen the newly made gabion structures.
- c) **Land Development works:** About 150 ha of arable land in the watersheds were provided with field bunding. Non arable area has been treated with rock fill dam and gabion structures. This will ensure better moisture conservation and improved moisture retention in agricultural fields.

Conservation and management of Natural Resources in Ramasagara watershed, Chitradurga District, under the NWDPRA (MMA) scheme.

A total of 300 ha area has been covered with field bunds in 1-3% slopes in farmers' arable fields. Castor, greengram and horsegram crops were cultivated on bunds for stabilization and utilization of the bunded areas. *Stylosanthes hamata* was also sown on the newly formed bunds for their stabilization and increase in the availability of fodder for cattle in the watershed. For draining out water safely from non-arable lands, a diversion drain was constructed all along the foot of hillocks in upper, middle & lower reach of the watershed and 144 waste weirs were constructed covering an area of 246 ha in the arable lands. The original drainage line was also restored by widening and deepening the *nala* for safe flow of rainwater through arable lands. Repairs and modification to an existing check dam (gully control structure) was carried out and modified into a gauging station for runoff measurement from a catchment area of 97 ha.

Socio-economic analysis and policy development for watershed management

Relative performance of watershed development projects under different Institutional structures in semi-arid Karnataka and Andhra Pradesh: Analysis of data collected indicated that beneficiaries' participation ranged between 47 to 87 % under different watersheds under study. The stakeholder institutions were found to be weak due to poor mobilization of people from different sections of the society.

Evaluation of Institutional Arrangements and Impact of Community Based Water Storage Structures in Agro-climatic Zones of India: Well managed tanks are those managed by the Minor Irrigation Department of the State Government, using a queue system depending upon the availability of water. The tanks looked after by the village community through a society, is maintained badly and is insufficient to meet the requirements of the farmers.

Constraints analysis and methodologies for transfer of technologies in watershed programmes in Bellary district: The knowledge level of field staff with regard to 125 technologies ranged from 40% to 70%; state department staff bettered the NGO staff by 42%.

Status and constraints of technologies (that were passed on to extension functionaries)

- Two important soil conservation technologies with wide applicability, which have been demonstrated to state functionaries are compartmental bunding and graded bunding with ponds (to store run off) in Vertisols. However, these two technologies yet to become popular in the dry Vertisols.
- Most training programmes rarely deal with technical issues but focus more on formation of SHGs & UGs. Self-help groups and other village level institutions are effective only when services and products emerge out of integrated programmes. This issue is a major constraint which needs to be looked into.

CHAPTER VII

STATUS OF RESEARCH IN AGRICULTURAL ENGINEERING

Infrastructure

Following institutes / regional stations of the institutes under the SMD of Agricultural Engineering are located in this region:

1.	Central Institute of Agricultural Engineering, Regional Centre	Coimbatore
2.	Quality Evaluation Unit of Central Institute for Research on Cotton Technology	Coimbatore

Following All India Coordinated Research Projects are in operation at different ICAR Institutes / SAU's located in region VIII:

S. No.	AICRP	Centre
1.	Farm Implements and Machinery	Coimbatore, TN
2.	Post Harvest Technology	Coimbatore, TN
3.	Renewable Energy Resources	Coimbatore, TN
4.	Ergonomics and Safety in Agriculture	Coimbatore, TN
5.	Utilization of Animal Energy	UAS, Raichur, Karnatka
6.	Farm Implements and Machinery	UAS, Raichur, Karnatka
7.	Post Harvest Technology	UAS, Raichur, Karnatka
8.	Renewable Energy Resources	UAS, Dharwad, Karnatka
9.	Post Harvest Technology	UAS, Bangalore
10.	Renewable Energy Resources	Tavanur, Kerala
11.	Farm Implements and Machinery	Tavanur, Kerala
12.	Post Harvest Technology	Tavanur, Kerala
13.	Post Harvest Technology	CTCRI, Trivandrum
14.	Post Harvest Technology	CPCRI, Kasaragod
15.	Post Harvest Technology	TANVASU, Chennai

Progress of research:

Farm Machinery

- The transplanters available for rice were studied and based on the availability and row spacing requirement, the Yanji type transplanter was modified. Transplanting trials were conducted with template seeded nursery. The percentile distribution of seedlings per hill in template seeded field was 38.9 with one seedling, 28.7 with two, 11.8 with three, 1.7 with four and 18.2 missing (empty).
- A twin row engine operated 'Power Weeder for SRI Cultivation' having weight of 17 kg and provided with float and rotary cutting blades has been developed with the help of Premier Power Equipments & Product Pvt. Ltd. Coimbatore. The commercial model manufactured under the brand name 'Garuda' can cover 0.70 ha/day. The weeder has been approved for supply under subsidy schemes of Tamil Nadu, Andhra Pradesh, Orissa, Bihar and Chhattisgarh.

- A needle type tray seeder for vegetable nursery production has been developed. The machine automates the complete process of filling the trays with growth media, compaction, sowing of seeds, topping up with media etc. About 80 sown trays can be prepared in an hour. The cost of operation works out to Rs 350/day for sowing 600 trays/day. The savings in cost and labour is about 117 % and 60 % respectively. The cost of the unit is Rs. 30,000 only.
- A tractor mounted aerial access hoist has been designed to access the coconut trees up to crown and four trees can be accessed from a single position. The time required for locating unit and operating stabilizers is 1 minute. The time required for positioning against a tree of 10 m height is 2 minutes. Suitable safety devices have been incorporated to ensure stability of the hoist. The positioning of the operator platform is done by the operator himself using electro hydraulic controls.
- Mechanical de-huskers to reduce the labour requirement for de-husking fresh arecanut were developed and evaluated. The de-husking efficiency was 39 to 46 % in Model-I and 53 to 67% in model-II. The breakage was observed in the range of 8 to 10%. The unit will operation.
- A commercially available groundnut combine suitable for harvesting green pods was imported from China and evaluated under Tamil Nadu field conditions. The soil and crop characters during field test were recorded. The digging and conveying efficiency of harvester were calculated. The self-propelled groundnut combine was mostly suitable for raised bed system of groundnut cultivation. The highest stripping efficiency of 94.2% and lowest un-threshed pod of 6.9 % was observed in self-propelled groundnut combine under laboratory tests with drum speed of 300 rpm.
- Power Operated Sugarcane Bud Chipping Machine, Pneumatic Model Sugarcane Bud Chipping Machine, Mechanical Planter for Seedlings raised from sugarcane bud chips, Improved Manual Rice Transplanter and Potting Media Filling Machine for Spices Nursery have been developed.

Renewable Energy

- Twenty isolates of micro algal cultures were isolated and purified for algal biofuel production utilizing potential algae. Similarly, 20 isolates of cellulolytic yeast strains were isolated for production of ethanol from lignocellulosic biomass. The steam pre-treatment of lignocellulosic substrates increased recovery by 60-70%.
- Four units of 45 m³/d capacity modified Janata biogas plants for solid state fermentation of cattle dung were installed and commissioned at users' sites. These are functioning well. A bio-methanation system for biogas production from fruit wastes was designed and installed in a fruit processing industry in PPP mode. High TSC biogas plant of 35 m³/d capacity for power generation was demonstrated at a selected dairy farm. Fixed dome type (4-8 m³) high TSC cattle dung based biogas plant was also demonstrated and evaluated.
- One unit of 900 Wp improved CIAE Sun Tracker coupled with SPV panel for water pumping was installed and evaluated at the UAS, Raichur centre The SPRERI SPV Solar Refrigerator was demonstrated for its utility at veterinary clinics in selected ORP sites.
- Pilot plant for ethanol production from paddy straw has been developed. Process parameters for maximum bio-oil recovery have been standardized and a fast pyrolysis reactor (10 kg capacity) has been designed.

Utilization of Animal Energy

- A bullock drawn engine operated sprayer for cotton and pigeon pea was developed. The bullock operated sprayer had a capacity of 0.66 ha/h but discharge was only 288 l/ha which was less than the desired rate. The cart mounted engine had field capacity of 0.66 ha/h but discharge was 786 l/h. The developed bullock drawn engine operated sprayer had a

significantly higher field capacity of 1.20 ha/h and discharge of 580 l/h. This resulted in 90% decrease in cost and significant increase in timeliness of operation.

- Animal drawn implements like 900 mm blade harrow, 600 mm interculture blade hoes and four tyne sweep type cultivator were developed for use with single Khillari bullocks. Field capacities observed were 0.14, 0.097 and 0.13 ha/h, respectively.

Post Harvest Technology and Value Addition

- A low cost manually operated *Aloe vera* extractor consisting of one pair of tapered roller with varying clearance to accommodate leaves of differing thicknesses was developed. It yields higher quantity of juice compared to manual extraction. It has a capacity of 12 kg gel/h.
- Pomegranate Aril Extractor has been developed to separate arils from pomegranate. It processes whole pomegranate at a rate of 30 - 35 fruits/minute with extraction capacity of 90 - 94 % and about 2-4 % damage.
- A hand tool "Banana Comb Cutter" has been developed to improve the operation of cutting and separating the banana combs/hands from bunches. The cost of the tool is around Rs 150, and 2 - 6 % loss can be prevented by adopting the hand tool.
- A soft rubber roller suitable for D.R. gin has been designed in collaboration with M/s. Millennium Rubber Technology Ltd., Kerala. This roller has longer life than the conventional roller. It circumvents the contamination of chromium in the lint and it is possible to get 30% higher lint output with reduced speed of 39 rpm.
- A coconut fibre segregator has been developed to segregate fibres into three categories based on the fibre fineness into coarse fibres ($>350\ \mu$), medium ($250-350\ \mu$) and fine fibres ($<250\ \mu$). This method of segregation of fibres is helpful for value addition to the end products. It can also be used for the preparation of technical textiles.
- A low cost polyethylene based natural convection solar dryer of 5 - 10 kg capacity was designed, developed and evaluated for mushroom drying.
- A process for making green chilli powder has been developed and standardized. Processing of green chillies avoids lengthy ripening in the field, reduces losses and provides the chilli powder with controlled pungency. 150 gram green chilli powder can be obtained from 1 kg fresh green chillies.
- Equipment and process has been developed for making chicken based nuggets and sausages. These can be blended with vegetables to enhance their nutritional status (more dietary fibre and antioxidants).
- Bio-coatings from chitosan and cassava starch extended the shelf life of mango and guava by 8 and 7 days, respectively. Shrink wrap packaging extended the shelf life of guava to 12 - 15 days under ambient conditions, whereas it extended shelf life of mango to 32 days under low temperature storage.
- Digestibility trials of bio-enriched cottonseed hulls was undertaken on cross-bred bulls at Sabarmati Gaushala, Bidaj farm near Ahmedabad. It showed improvement in digestibility from 17 % to 26% after incorporating bio-enriched cotton seed hulls in the regular feed ration.

TAMIL NADU AGRICULTURAL UNIVERSITY

Farm Implements

1. **Needle type tray seeder for vegetable nursery:** Singulated raw / pelleted seeds placed in all the cells in a single stroke; Cost of operation is Rs.280 for sowing 750 trays / day; Saving of 60% labour and 52% cost; Cost of equipment is Rs.10,000 including the vacuum source.

2. **Trailer mounted steering for power tiller – trailer system:** Avoids the operator getting down and turn the power tiller trailer system; All the control operations within the reach of the operator; Shorter turning radius, enabling the operator to take turns even in very narrow space; Operator feels comfortable while taking a turn; Reduced discomfort to the operator through elimination of lateral and vertical swing of the handle; Cost of the steering system is Rs.1,000.
3. **Self-propelled flail-mower for cutting grasses and bushes:** Very low energy consumption; Cutting weeds and grasses without disturbing the soil; Weeding closer to tree trunks; Suitable for rough terrain; Ideal for parthenium clearing; Useful for clearing playgrounds & lawn mowing.

Horse power	13 hp power tiller with single cylinder water cooled diesel engine
Fuel consumption	2 l/h
Cost of operation	Rs.1800/ha
Coverage	0.10 ha/h (2.0 acre/day)
Cost of implement	Rs.7000/-
4. **Palmyrah tree climbing device:** To ease palmyrah tree climbing even for unskilled workers; Feasibility to move up and down; Set of upper and lower frames alternately used to grip the tree for climbing up or down; Adjustable according to palm's girth; Aluminium ladder of 3m height with a hoop to lock to the tree with foldable top for positioning the climbing device.

Weight	: 17 kg
Cost of device with ladder:	Rs.6000/-
5. **Automatic protray sowing machine for vegetable nursery production:** Protrays fed on the conveyor automatically filled with media in each cell row-wise and topping up the tray after sowing; Compacting device to press the media down; Seed picking arm with a row of 7 needle pickers to drop seeds; Optical sensor to stop the seed pick / drop action.

Cost of operation:	Rs.350/day for sowing 600 trays/day
Cost of the unit	Rs.30,000/-

Technologies

- Sorghum composite biscuits

UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

- Hand operated Cycle weeder has been redesigned to save labour costs and reduce drudgery. Using this weeder, one labour can weed an area of 0.4 ha/day as against 12 women labourers to cover the same area through hand weeding.
- Labour saving hand operated groundnut decorticators (Models 4 and 5) with capacity to shell 150 and 200 kg pods/day have been designed and recommended.
- Hand operated UAS, Bangalore groundnut decorticator cum castor sheller reduces drudgery and saves labour cost. On an average, a labourer can shell 225 kg/day with lower damage of 0.8 % compared to local method of stone rolling (194 kg/day and damage 1.77 %).

UNIVERSITY OF AGRICULTURAL SCIENCES, RAICHUR

The following equipment / machineries have been introduced in the region.

1. Paddy transplanter (Walk behind type and riding type)
2. MPKV planter for Jowar (Tractor Drawn)
3. Groundnut Thresher

4. Sunflower Thresher
5. High capacity Thresher for sunflower, safflower etc.
6. Low land and Rice Seeder
7. Cono weeder
8. Inclined plate planter (Animal drawn)
9. Self-Propelled high clearance sprayer
10. Rotovator
11. Self-propelled vertical conveyer reaper
12. Long boom sprayer
13. Roto-till drill
14. Vertical conveyer reaper (Tractor mounted)
15. Flow through paddy thresher
16. Groundnut pod stripper
17. Wheel hoe

The performance of all the above equipment in the field was good and by the use of these equipment, the cost of cultivation was reduced (between 6% - 59%) and also time was saved (between 20% - 68%) in doing agricultural operations.

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

- Developed Bed former suitable for Pokkali area with float unit as an attachment, Motorized pepper harvester, self-propelled ginger harvester, coleus peeler & black pepper decorticator
- Evolved cost effective method of extraction of natural vanilla from *Vanilla planifolia*
- Developed portable split biogas plant suitable for farmers with one cow or only small animals and portable light trap for pest monitoring in rice

CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING REGIONAL CENTRE, COIMBATORE

The centre provides manufacturing and marketing assistance to small manufactures in commercialization of small farm equipment developed by the research institutes and strives to liaison with farmers and manufacturer in the adoption of the equipment

Salient research achievements

Power operated sugarcane bud chipping machine: Capacity of the machine is 1200 bud chips/hour compared to 125 - 150 bud chips/hour under conventional method. The cost of the equipment is Rs 30,000. Savings in cost of operation and savings in time is to the tune of 57.12 and 90 percent, respectively

Pneumatic model sugarcane bud chipping machine: The pneumatically operated sugarcane bud chipping machine consists of outer frame, bud chipper to chip the buds and an air compressor with a pneumatic cylinder. About 1000 bud chips can be taken per hour compared to 125-150 bud chips per hour under conventional method. The cost of the equipment is Rs 15,000 (excluding air compressor). Savings in cost of operation and savings in time is 61.45 and 88 percent, respectively

Development and evaluation of mechanical planter for seedlings raised from sugarcane bud chips: A tractor operated planter for sugarcane bud chip seedlings in polybags has been developed in collaboration with Sugarcane Breeding Institute, Coimbatore. The field capacity of

the machine is about 0.15 ha/ h. The cost of two row tractor operated sugarcane bud chip seedling planter is Rs 50,000. The cost of planting/ha was Rs 2210 with the bud chip seedling planter while it was Rs.8950 when done manually.

Mechanization package for sugarcane bud chip nursery raising: Development of mechanization package for sugarcane buds nursery raising and studies on post-harvest storage and transportation of sugarcane bud chips has been taken up in collaboration with Sugarcane Breeding Institute, Coimbatore. The fabrication of the prototype equipment for portray filling and seeding is in progress.

Improved Manual Rice transplanter: The three row manual transplanter was developed by modifying functional components of six-row IRRI rice transplanter. The unit is capable of planting seedlings at 250 mm row spacing. The draft requirement to operate the equipment was 261.7 N. The energy requirement has been reduced (24.8%) with the modified transplanter compared to IRRI manual transplanter. The operation of the equipment has registered cost saving of 80.8 % and time saving of 91.3 % compared to manual method of transplanting.

Potting media filling machine for spices nursery: This power operated continuous type potting machine developed in collaboration with Indian Institute of Spices Research, Kozhikode, Kerala is capable of mixing, pulverizing, sieving, and filling of potting ingredients in poly bags at desired quantity. Two operators can safely and comfortably work with the machine in standing and sitting position. The cost of the unit is Rs. 1 lakh. Working capacity of potting machine is 200 bags/h (bag size: 500g). Saving in cost and time over conventional method are 71.4 and 80.2 per cent respectively.

Batch type root vegetable washer: A mat type root vegetable washer consisting of a stainless steel drum of 47 cm length and 39 cm diameter and with 0.65 mm perforation holes has been developed. The capacity of the drum is about 10 kg per batch. The washing and cleaning efficiency were found to be 97 & 91% respectively for carrot and 96 and 90% respectively for radish. The cost of washing one kg of carrot was Rs. 0.6/-. Savings in cost was 52 %. The savings in labour for washing is about 80%.

Continuous feed type root vegetable washer: A continuous feed type washer for root vegetable has been developed. The washing efficiency was found to be 86 % and the cleaning efficiency was 85% for radish and two passes of washing were required for cleaning of radish. The capacity of the equipment was worked out to be 350 kg/h for washing carrot. The cleaning efficiency was about 88 % for carrot.

Continuous feed equipment for extraction of *Aloe vera* Gel: Continuous feed type equipment for extraction of *Aloe vera* gel has been developed. The capacity of the equipment is about 200 - 225 kg/h (900- 1000 leaves/hour) when motorized and 100kg/h (400-450 leaf/h) when operated manually. The cost of the unit is about Rs 40,000.

Transfer of Technology programme

Entrepreneurship development for processing equipment at the selected village in Coimbatore district: Entrepreneurship development with a village youth self-help group for turmeric and onion processing equipments for value addition has yielded encouraging results. An enterprising village youth SHG, consisting of six male members of Sangampalayam village in Coimbatore district, Tamil Nadu was identified and motivated to initiate revenue generation activities with steam operated turmeric boiler, turmeric polisher, multiplier onion peeler, and dairy as APC activities. The SHG has been successful in carrying out the primary processing operations on turmeric by using post harvest machinery under custom hiring basis.

Patents: CIAE IEP Coimbatore also filed following patents

1. Pedal Operated Sugarcane Bud Chipping Machine along with Sugarcane Breeding institute Coimbatore
2. Pneumatically Operated Sugarcane Bud Chipping Machine along with Sugarcane Breeding institute Coimbatore
3. Power Operated Potting Machine For Spices Nursery with Indian Institute of Spices Research, Kozhikode, Kerala

CENTRAL INSTITUTE FOR RESEARCH ON COTTON TECHNOLOGY- REGIONAL QUALITY EVALUATION UNIT, COIMBATORE

Contribution to cotton quality improvement through AICCIP

Samples from AICCIP and other research trials were tested for different fibre quality parameters in High Volume Instrument (HVI) and Advance Fibre Information System (AFIS). More than 5600 samples including 430 from AICCIP and 1450 other research samples were analysed for Span length, uniformity ratio, Tenacity and Micronaire.

A Value chain for cotton Fibre, Seed and Stalks: An innovation for Higher Economic Returns to Farmers and Allied Stake Holders

- The level of contamination in cotton has been brought down to 0.2 % by adopting on-farm and off-farm management practices.
- Bales labeled with fibre quality attributes after appropriate ginning for easy selection of bales for mixing in the Spinning Mill.
- Quality yarn and fabrics have been produced in Modern mill by employing CIRCOT technology.
- Best cotton harvesting practices initiated among farmers in the above adopted village to fetch premium price for the produce

R & D efforts on Cotton

- In the multi-fibre free trade regime, the base of cotton as a natural fibre could be strengthened by projecting its positive attributes, adding value to the fibre as well as textiles made there-from by carrying out appropriate researches to overcome its deficiencies.
- The centre has been focusing its research on identifying the pristine qualities of cotton by accessing the fibre quality parameters of germplasm accession using modern instruments. The superior fibre quality accessions from the gene bank have been utilized to improve both the genotypes and bring about both quantitative and qualitative changes.

Extension Activities:

- Thousands of commercial samples have been analyzed for fibre quality on payment basis to enhance revenue and to help the industry to choose the best cotton, processing the right blend of fibre attributes for yarn manufacture.
- Marketing and Popularization of CIRCOT calibration cotton: CIRCOT on regular commercial basis makes the calibration cotton available for Indian industry. This import substitute has been well received and the patronage by the Indian industry is on the rise. The centre has been able to create a customer base of more than 100 users.

CHAPTER VIII

PROGRESS OF RESEARCH IN ANIMAL SCIENCES

KARNATAKA

Livestock and Poultry

Karnataka has 0.9 million crossbred cattle, 1.5 million non-descript cattle and 1.6 million buffaloes in milk, producing around 4.8 million tonnes of milk, cows contributing the major share (3.3 million tonnes), besides 42.0 million poultry contributing 2.9 billion eggs per annum. Among small ruminants, the population of sheep is 9.6 million and that of goats 6.2 million. The state has great potential to enhance productivity of cattle, buffalo and poultry with the following technologies:

- Improved germplasm of Frieswal cattle and Murrah buffalo for 5 % increase in milk production
- Crystoscope assisted Artificial Insemination for improved conception rate by 20%
- Field based diagnostic kits (Bovine viral diarrhoea, Infectious bovine rhinotracheitis, foot and mouth disease, Pestes des petitis ruminants) and vaccines (Foot & Mouth, Hemorrhagic septicemia, Blue tongue) for enhanced production and income.
- Sero-surveillance, control and monitoring of diseases for their control.
- Implementation of novel techniques for study of disease pattern in animals vis-à-vis human from public health view point.
- Urea-ammoniation of straws, area-specific mineral (Ca, P, Cu and Zn) supplementation and By-pass protein technology for 10-15% improvement in productivity
- Hormonal modulation of poultry in organized farms for 5% increase in egg production
- Value addition and improving shelf life of poultry (chicken meat idli, kababs, patties) and milk products (mango lassi, whey-based sports beverage, gasagase payasam, low cholesterol ghee, mozzarella cheese)
- Application of novel estrus synchronization protocols of ovsynch and heatsynch followed by fixed time artificial insemination.
- Trainings in fertility management to stakeholders, field veterinarians.
- Trainings in commercial meat products development and clean meat production.

KERALA

Livestock and Poultry

Kerala has 0.7 million crossbred cattle producing 2.2 million tonnes of milk annually. The state has 1.7 million goats and 15.7 million poultry contributing 1.6 billion eggs. Although the state has utilized the potential to a large extent, it has further scope to enhance productivity of cattle, goat and poultry, with the following technologies:

- Crystoscope assisted Artificial Insemination for improved conception rate by 20%
- Complete feed block, area specific mineral mixture (Ca, P, Cu, Mn) and bypass protein technology for 10 - 15% improvement in productivity.
- Hormonal modulation of poultry in organized farms for 5% increase in egg production
- Field based diagnostic kits (Bovine viral diarrhoea, Infectious bovine rhinotracheitis, Brucellosis, PPR) and vaccines (Foot & Mouth) for enhanced production and income.
- Strategic planning for study of mycotic and parasitic diseases, as they cause irreparable loss to the livestock sector in the state.

- Value addition and improving shelf life of milk (low cholesterol ghee, mango lassi, whey-based sports beverage, kesar kulfi and flavoured milk)
- Application of novel estrus synchronization protocols of ovsynch and heatsynch followed by fixed time artificial insemination.
- Trainings in fertility management to stakeholders, field veterinarians.
- Trainings in commercial meat products development and clean meat production.

TAMIL NADU

Livestock and Poultry

Tamil Nadu has 1.8 million crossbred cattle, 0.8 million non-descript cattle and 0.5 million buffaloes in milk, producing around 5.8 million tonnes of milk, cows contributing the major share (5.0 million tonnes), besides 128.1 million poultry population contributing 10.8 billion eggs per annum. Among small ruminants, the population of sheep is 8.0 million and that of goats 9.3 million. The state has great potential to enhance productivity of cattle and poultry with the following technologies:

- Crystoscope assisted Artificial Insemination for improved conception rate by 20%
- Complete feed block, urea treatment of poor quality fodder, area specific mineral (Ca, P, Cu, Zn) supplementation and bypass protein technology for 10-15% improvement in productivity.
- Hormonal modulation of poultry in organized farms for 5% increase in egg production
- Field diagnostic kits and vaccines (FMD, HS, IBR) for enhanced livestock production and income enhancement of livestock keepers.
- Study of vector borne diseases in the livestock and stress and metabolic related diseases in small ruminants.
- Implementation of proper health management system for poultry.
- Value addition and improving shelf life of milk and poultry products
- Capacity building of stakeholders for piggery development using modern management practices.
- Application of novel estrus synchronization protocols of ovsynch and heatsynch followed by fixed time artificial insemination.
- Trainings in fertility management to stakeholders, field veterinarians.
- Trainings in commercial meat products development and clean meat production.

PUDUCHERRY

Livestock and Poultry

In Puducherry, the major livestock population is 20,000 crossbred cattle with milk production of 46,000 tonnes and poultry (0.39 million) contributing 11.3 million eggs per annum. The state can enhance productivity of cattle with the following technologies:

- Improved germplasm of Frieswal cattle for 5 % increase in milk production
- Crystoscope assisted Artificial Insemination for improved conception rate by 20%
- Field based diagnostic kits and vaccines (FMD, HS and BT) for enhanced production and income generation.
- Application of novel estrus synchronization protocols of ovsynch and heatsynch followed by fixed time artificial insemination.
- Trainings in fertility management to stakeholders and field veterinarians.
- Trainings in commercial meat products development and clean meat production.

- Study of vector borne diseases in the livestock and stress and metabolic related diseases in small ruminants.
- Implementation of proper health management system for poultry.

LAKSHADWEEP

Livestock and Poultry

In Lakshadweep, the major livestock population is 4000 crossbred cattle with milk production of 2,000 tonnes and poultry (0.17 million) contributing 13.8 million eggs per annum. The state can enhance productivity of cattle with the following technologies:

- Improved germplasm of Frieswal cattle for 5 % increase in milk production
- Cryoscope assisted Artificial Insemination for improved conception rate by 20%
- Field based diagnostic kits and vaccines (FMD, HS, Brucellosis) for enhanced production and income generation
- Improved breeds/strains for backyard poultry laying 170 eggs/year for improving rural poultry production
- Application of novel estrus synchronization protocols of ovsynch and heatsynch followed by fixed time artificial insemination.
- Trainings in fertility management to stakeholders and field veterinarians.
- Trainings in commercial meat products development and clean meat production.

Important Achievements of ICAR Institutes / AICRPs

Karnataka

National Institute for Animal Nutrition and Physiology, Bengaluru

- Mineral mapping done.
- Area-specific mineral mixture developed.
- Locally available feed resources assessed.
- Biochemical markers developed for assessing mineral status.
- Hormonal modulation for enhancing poultry production developed.

AICRP on Improvement of feed resources and nutrient utilization in raising animal production (NIANP, Bengaluru)

- Region specific resource based feeding schedules
- Developed for coastal and rainfed zones.

Southern Regional Station of National Dairy Research Institute, Bengaluru

- Indigenous technology for production of value added milk products developed.
- Several indigenous products like gasgas payasam, palada payasam etc. commercialized.

Network project on R&D Support for Process Upgradation of Indigenous Milk Products for Industrial Applications (SRS of NDRI, Bengaluru)

- The centre has successfully transferred the technology for manufacture of Palada Payasam dry mix and also developed two new products like Kashi Halwa and Chhana Jhilli and making efforts for commercialization and upscaling the technology.
- A method for the preparation of ready to reconstitute payasam dry mix incorporating ground green gram dal and poppy seeds and skim milk powder was standardized. Trials were conducted on dry mix preparation and a dry product containing either sucrose (50%) or sucralose (3200 ppm).

- Developed ready to reconstitute malted foxtail millet – milk solids dry mix using foxtail millet malt powder, sugar and skin milk powder.
- Developed ready to reconstitute popped ragi malt-milk beverage dry mix has been standardized with improved aroma, texture and shelf life.

AICRP on Poultry Breeding (KAVFSU, Bidar)

- The average 5 week body weight in PB-2 and PB-1 strains was 1052 and 1123 g which was 115 and 160 g higher than the previous generation.

Mega Sheep Seed Project (KAVFSU, Bidar)

- New initiative during 11th Plan. A total of 5 centres comprising of 300 to 800 sheep per centre have been identified.

Network project on Blue Tongue (Institute of Animal Health & Veterinary Biologicals, Bangalore)

- An Indo-UK collaborative project entitled “Monitoring and Intervention strategies for Bluetongue virus epidemics in rural India” is also functioning under this project and the centre is actively involved in collection of the data for Bluetongue virus epidemics in the state. It has improved overall productivity of sheep husbandry by small holders and landless workers in the state.

Outreach Programme on Environmental Pollutants (PD ADMAS, Bangalore)

- Monitoring of heavy metals, viz., lead, cadmium and arsenic residues in milk, blood, hair, dung, feed, fodder, water and soil samples in mining area of Bellary District of Karnataka and industrial area of Bangalore urban was conducted.

Outreach Programme on Zoonotic Diseases (PD ADMAS, Bangalore)

- Monitoring and sero-surveillance of the region for Leptospirosis, Listeriosis and Brucellosis was carried out with interactive support from State Animal Husbandry Departments.

Outreach Programme on Zoonotic Diseases (COVS, Bangalore)

- Work in the areas of rabies and anthrax is continued.

Network programme on Veterinary Type Culture (NIANP, Bangalore)

- PCR amplification and sequence analysis of the ITS1 region of anaerobic fungi was done

Network programme on Veterinary Type Culture (Dairy Science College, KVAFSU, Bangalore)

- Isolated and characterized lactic acid bacteria namely *Lactobacillus streptococcus* *Lactococcus* spp. and *Streptococcus theruophilus* from dahi from various regions of Karnataka
- Bacterial cultures characterized upto speices level.
- Identification done for 35 of the above mentioned isolates.

AICRP on Foot and Mouth Disease (Institute of Animal Health & Veterinary Biologicals, Bangalore)

- 27 outbreaks cases were reported in the state of Karnataka and all were caused by type O virus attack.
- Highest number of outbreaks were recorded from Chikkaballapur (16) followed by 3 each in Bangalore Rural, Shimoga & Dakshina Kannada, 2 each in Mandya, Gulbarga & Tumkur and 3 each in Hassan, Udupi & Mysore.

- Maximum number of outbreaks were recorded during January (9) followed by November (5), August (4), December (3), February (2), and (1) each in April, May & March.

AICRP on Animal Disease Monitoring and Surveillance (Inst. of Animal Health & Veterinary Biologicals, Bangalore)

- Development of spreadsheet modules for economic impact analysis done.

AICRP on Animal Disease Monitoring and Surveillance (PD ADMAS, Bangalore)

- 130 outbreaks were investigated (Haemorrhagic septicaemia – 20; Black Quarter – 7; Enterotoxaemia – 7; Anthrax : 3; Sheep pox & goat pox : 14; Pestes des petites ruminants – 13; Others including poultry – 48)

KERALA

AICRP on Goats (KAU, Thrissur)

- The centre is undertaking improvement of farmer's flock Malabari breed of goat by production and provisioning of quality breeding rams.

AICRP on Cattle (KAU, Thrissur)

- The average 305 days milk yield of the daughters from the first 8 sets showed an improvement from 1958 kg (range 1587 to 2164 kg) in the first set to 2402 kg (range 2000 to 2778 kg) in the 8th set. The 11th set (21 bulls) was inducted for field progeny testing.

AICRP on Poultry Breeding (KAU, Mannuthy)

- Hen housed egg production upto 72 weeks of age of IWN and IWP layer strains was 310 and 297 eggs respectively and of the IWN x IWP cross was 296 eggs under field conditions.

AICRP on Pigs (KAU, Mannuthy)

- The centre is maintaining and supplying 50% and 75% crossbred of large White Yorkshire into local pigs as well as a three breed cross (Desi x LWY x Duroc) to the farmers for fattening and income generation. The centre has also established around 200 piggery units throughout the state.

AICRP on Improvement of Feed Resources and Nutrient Utilization in Raising Animal Production (KAU, Thrissur)

- Mineral mapping done.
- Area-specific mineral mixture developed.
- Locally available feed resources assessed.

Network Project on Buffalo Improvement (KAU, Thrissur)

- New initiative in 11th Plan. Nucleus herd is being established.

TAMIL NADU

AICRP on Improvement of feed resources and nutrient utilization in raising animal production (TANUVAS, Chennai)

- Mineral mapping done.
- Area-specific mineral mixture developed.
- Locally available feed resources assessed.

AICRP on Pigs (TANUVAS, Kattupakkam)

- The centre is maintaining 50% and 75% crossbred of large White Yorkshire x indigenous pigs and also providing these animals to the farmers for fattening and income generation.

Network Project on Sheep Improvement (TANUVAS, Chennai)

- The centre is undertaking evaluation and genetic improvement of Madras Red Sheep for mutton production in farmers' flocks. During 2010-11, a total of 9137 sheep were covered. The average 12-month body weight of 22.2 kg was recorded. A total of 8055 sheep were vaccinated against FMD and sheep pox and 3390 lambs were born from 3393 available breedable ewes with a lambing percent of 84.90.

Network Project on Animal Genetic Resources (In situ Conservation Unit – Kilakarsal Sheep & Core Lab (TANUVAS, Chennai)

- The University is maintaining a flock of Kilakarsal sheep and rams have been supplied to farmer's flocks under this project.
- Molecular characterization based on FAO markers in progress.

Outreach programme on Methane emission (TANUVAS, Chennai)

- Revealed lowest degradation rate for ragi straw and highest for mulberry leaves and gingelley oilcake.

Mega Sheep Seed Project (TANUVAS, Chennai)

- A total of 175 progressive farmers with 6458 breedable ewes were registered. A total of 42 breeding rams were distributed to the field units.

Network Project on Haemorrhagic septicaemia (TANUVAS, Chennai)

- Molecular characterization of *Pasteurella multocoda*

Network Project on Gastro Intestinal Parasitism (TANUVAS, Chennai)

- Mapping of G.I. parasites have been mapped in different agro-climatic regions
- Development of Bio-climatograph for gastro-intestinal nematode infestation in small ruminants

Network Project on Blue Tongue (TANUVAS, Chennai, Tamil Nadu)

- Production of Saponified Inactive Pentavalent Blue Tongue vaccine and transfer of the technology to IIL, Hyderabad and Biovet, Bangalore.

Outreach Programme on Environmental Pollutants (TANUVAS, Chennai)

- Tissue depletion studies of levofloxacin in poultry conducted and procedure for determination of doxycycline in chicken plasma was standardized and microbiological assay of gentamicin using *Bacillus subtilis* standardized.

Outreach Programme on Zoonotic Diseases (TANUVAS,, Chennai)

- Monitoring and sero-surveillance of leptospirosis, anthrax and Japanese encephalitis carried out in the region. Various techniques have been standardized and efforts are under way for development of suitable diagnostics and control measure for the disease.

Network programme on Veterinary Type Culture (TANUVAS, Chennai)

- A total 14 bacterial isolates from three different laboratories were deposited along with fungal isolates
- PCR amplification and sequence analysis of the ITS1 region of anaerobic fungi

AICRP on Foot and Mouth Disease

- 13 FMD cases / outbreaks were recorded. Highest number of cases (7) were reported during the months of January followed by 2 each in the months of November, February and December. Maximum number of cases was reported from Dindukal district (3).

KERALA VETERINARY AND ANIMAL SCIENCES UNIVERSITY

- The Malabari breed of goat was characterized and study of socioeconomic status of its farmers was completed. The growth, production and reproduction traits were ascertained. Genetic parameters viz. heritability, genetic and phenotypic correlations, genetic trends and breeding value of the bucks were estimated. Genetic trends were found to be positive and efforts are being made to store the semen of superior ranking bucks for future use.
- Economic rations were evolved using conventional / unconventional feeds such as brewer's yeast and dried tuna (*Tunmus albacares*) waste silage as a substitute for dried fish in the rations of growing / finishing pig on protein basis.
- Molecular studies initiated on genetic variability in *Desi* and crossbred pigs with respect to Prolactin Receptor and Follicle stimulating hormone β - locus and characterization of candidate genes to identify genotypic variants of Fucosyl transferase 1 (FUT1), 17-beta-hydroxysteroid dehydrogenase (HSD 17- β), Steroid 21 hydroxylase (CYP21), Estrogen receptor 1 (ESR1), Erythropoietin receptor (EPOR) and Epidermal growth factor (EGF) and association with litter traits.
- Twenty one isolates of *P. multocida* were made, among which two biotypes were observed. All of the isolates were demonstrated to be of serogroup A and were uniformly sensitive to norfloxacin, gentamicin, cephalexin, nitrofurantoin, erythromycin and chloramphenicol. Resistance was observed to penicillin, metronidazole, oxacillin, sulphadiazine and metronidazole. Oil adjuvanted vaccines offered better protection compared to saponin and aluminium hydroxide adjuvanted groups. *Pasteurella* bio films although found to be weak in inducing a primary immune response, evoked a more powerful secondary response compared to planktonic cells.
- Deworming all calves at 8 - 16 days (single dose) with pyrantel or a broad spectrum anthelmintic can eliminate *Toxocara vitulorum* infection. To reduce the development of anthelmintic resistance, deworming in ruminants should not exceed two times per year
- A mineral-vitamin-amino acid mixture, specific for pigs reared on hotel waste alone was formulated. The mixture was tested in the field and found to improve growth and feed efficiency and reduced pre-weaning mortality
- Low SNF problem encountered in dairy cows under field condition was found to be due to inadequate feeding of concentrate feeds and was rectified when concentrate was fed according to their requirement.
- A few products like Healthy Whey (whey based beverage), Alma Whey, Paneer Pickle, Spiced Paneer, and new flavours of ice cream were developed. A mini milk processing system for low capacity fluid milk processing was developed.
- 6071 Artificial inseminations of 35 high pedigreed HF crossbred bulls have been carried out in the field. 684 female progenies born during the last two years have been

identified and ear tagged. 190 progenies of the test bulls calved during the last two years gave an average first lactation milk yield of 2635 kg against their contemporary milk yield of 2237 kg. I.e. progenies of the test bulls produced 400 kg more milk than their contemporary calvers.

- Assessment of toxicological effects of agrochemicals and antibiotic residues in cattle of Northern Kerala revealed that 25% of the total samples analyzed contain detectable levels of antimicrobial residues (Enrofloxacin and sulfadiazine, sulfadimidine), which were above maximum permissible residue limits.
- A facility for diagnosis of rabies was established and three techniques for rabies diagnosis, viz., Fluorescent Antibody Technique (FAT), Rapid Rabies Immunochromatographic test and Microscopic detection of negri bodies were standardized. Analysis of the geographical distribution of the positive cases revealed the concentration of cases in the periphery of the known forest ranges in central Kerala.
- Screening of animal, human, food and environmental samples for Listeriosis from Thrissur, Ernakulam, Kasaragod, Wayanad and Kannur districts of Kerala revealed a prevalence of 0.33 % in animals, nil in human, 1.6 % in environment and 0.125 – 1.5 % in food.
- Microbiological quality of duck eggs was evaluated at various points of the production chain in University Duck Farm, Mannuthy. Point of lay and sales counter was identified as critical control point. It was observed that Chitosan coating of eggs increased shelf life by seven days.
- Post thaw quality of goat semen could be improved significantly by using a chelating agent for seminal plasma GSP proteins.
- A new effective acrylic splint for treatment of fracture in animals was developed
- Higher levels of calcium, phosphorus and magnesium were observed in cattle reared in hilly terrains of Kerala.
- Subclinical blood parasitic infestation is prevalent among dairy cows after calving which can cause serious production losses.
- Clinical trials with hot aqueous extract of seeds of *B. frondosa* were found to eliminate amphistomes at a dose of 10 mg/kg and 20 mg/kg. Ointment containing 2% alcoholic extract of *Cassia alata* leaves was found to be effective to cure malazzesiosis.
- **Aishwarya Poultry Project:** Under this Project the farmers were distributed with a cage, high yielding 5 Athulya birds, 10 kg of feed and a kit with minimum medical support. Each Athulya bird can give upto 303 eggs/year. Aiswarya project envisages production of eggs under homestead condition with specially made cages using high yielding Athulya layers and commercial feed. This is a very convenient method for the urban area, semi urban as well as rural area and will ensure year round supply of eggs.
- **Thumburmuzhy Model Aerobic Composting Technique (TMACT):** The University has developed an aerobic composting technique more popularly known as the Thumburmuzhy Model or Gandhian Waste Management System. The composting technology is an ideal ferro- cement bin which effectively converts bio-waste to valuable manure. The model, is cost-effective and eco-friendly and ideal to deal with the garbage in Kerala. The energy produced due to bacterial growth creates a 75° C environment inside the plant, which prevents flies from laying eggs. Since moisture level is only 60%, the composting process will not create any odour. A filled-up plant takes about 90 days to finish composting and it is ideal for large communities like flat dwellers. Smaller units can be used by households and local government bodies. This waste management system is a recommended model by the UNDP's climate change community among the four ideal rural technologies for farmers of India and has been successfully implemented

by some farmers and also by the Amrita Group of institutions and Art of Living institutions.

- The Dairy plant with the help of NABARD has developed a method for milk processing in small units at farmers level. Here instead of initial pasteurization & refrigeration, the milk is heated to 75°C and maintained in an electrical tank until it is distributed. This is a cost effective and time saving method.
- The university dairy plant has developed Healthy whey. This product has completely natural, healthy and good source of protein and minerals. 200 ml costs Rs.5/-only. Whey based vegetable soup, paneer pickle, spiced paneer and new ice cream and sip up with beetroot and shoe flower extract have also been developed.
- Peda and Gulab jamun with isabgol and sesame suitable for diabetic patients has been developed.
- The University has developed a calf starter for calves 3 to 9 months old. The feeding of the starter produced 300-400 g weight gain and the calves came into heat by 13 to 15 months time.
- The END programme for orphan dogs where the animals are captured at young age of 6-8 weeks and are neutered, and given anti-rabies vaccination and are given to volunteers who wishes to keep dogs. The Early Surgical Neutering is a safe and effective way for Animal Birth Control Programme. The cost for capture, maintenances and surgery could be reduced.

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

- Studied the productivity and adaptability of Murrah buffaloes based on growth, milk production and reproductive parameters.
- Evaluated the production performance of the native Attapady black goat
- Vechur cattle conservation unit is functioning as a central germplasm centre for Vechur cattle. One of the Vechur cows maintained at the centre is recognized as the smallest cow in the world as per Guinness World Record Book released during last year.
- The rabbit farm is functioning as a source of seed material for broiler rabbits.
- The Vigova broiler duck production was found to be a viable and profitable enterprise suitable for wide adoption.

NATIONAL INSTITUTE OF ANIMAL NUTRITION AND PHYSIOLOGY, BANGALORE

Salient research Achievements

- Database on livestock feed resources was refined and updated. It has revealed deficit in DM from greens (23 %), concentrates (69%) and dry roughages (3%).
- Detoxified Pongamia, after hot percolation with hexane followed by extraction with methanol and water, could be safely incorporated up to 50 % in the ruminant feed as a replacement for soy bean meal.
- For the first time in the country, isolated a novel methanogenic archaea viz. *Methanoculleus marisnigri*, *Methanopyrus kandler* and *Methanococcus* sp. from ruminants.
- Meta analysis of available data on bypass protein requirement for cattle showed that 571 g bypass protein is required to produce 10 kg milk yield which is found to be closer to the NRC requirement of 600 g for *Bos taurus*.

- Using meta analytical methods, nutritive requirements like DMI, DCP and TDN for Indian lactating animals were predicted. The requirement for a 400 kg animal yielding 10 kg (4% FCM) milk is 11.9 kg DM, 1.09 kg DCP, 7.5 kg TDN and 113.2 MJ of ME.
- For the first time, copper chaperone for superoxide dismutase (CCS) and superoxide dismutase (SOD1) genes in sheep has been sequenced for application as molecular markers of copper status.
- Developed a process to generate Xylo oligosaccharides (neutraceutical) from ragi straw.
- Cost effective technology developed for production of chelated minerals.
- Isolated and characterized four novel probiotic strains (*E. subtilis*, *E. fecalis*, *E. faecium* and *Micrococcus* sp.) to be used as microbial feed additives.
- Optimized microbial protein synthesis in sheep with 15 g RDN per kg DOM levels in the diet.
- Tree leaves containing tannin having methane suppression properties have been identified.
- Database on methane production potential of various ruminant feed ingredients and diet combinations have been developed.
- Metaanalysis of 100 research studies reported globally revealed that out of the 39 factors screened, PMSG, protein fraction supplement and defined maturation media were the key factors that affect laboratory production of buffalo embryos.
- Supplementation of higher energy (20%) during pre-pubertal stage was shown to advance age at puberty by 6 months in buffaloes.
- The dynamic status of the buffalo endometrium during estrus cycle and early pregnancy in response to antioxidative enzymes status has been established.
- Technology developed for utilization of areca sheath as alternate roughage source for feeding ruminants.
- Newer layer house lighting management with red spectrum light of 675 nm wavelength to enhance egg laying potential of poultry developed.
- Two technologies viz. 'Utilization of areca sheath as alternate roughage source' and 'Feeding of Azolla green feed, as a protein supplement to dairy animals for increased milk yield' developed by the institute were disseminated to farmers through linkages developed with NABARD, KMF and GKVK.
- Four technical bulletins on: 1) Balanced ration for dairy animals 2) Complete feed block 3) Management practices for scientific dairy farming and 4) Alternate poultry production system were released in English and Kannada for the benefit of farmers during 2010-11.

PROJECT DIRECTORATE ON ANIMAL DISEASE MONITORING AND SURVEILLANCE, BANGALORE

Study on epidemiology and bacterial etiology of infectious abortions in livestock with special reference to brucellosis

- ❖ *Brucella* culture isolates recovered from clinical samples were characterized and typed by multiplex AMOS and Bruce PCRs as 28 *B. abortus* isolates. 2b gene based sequences were analysed. Genbank accessions were numbers obtained for 29 isolations from cattle, sheep, goat, pig and humans.

- ❖ **An indirect ELISA for screening brucellosis in sheep and goat** has been standardized and validated. Final patent has been obtained (NO. 01592/CHE/2008) and the kit is available with 250 and 450 test format for diagnosis of brucellosis in sheep and goat.
- ❖ **An indirect ELISA for screening brucellosis in swine** has been standardized. The ELISA test will be done upon request at the institute.
- ❖ **Common ELISA for diagnosis of brucellosis in livestock and humans:** To overcome the problem of using different ELISA protocols, a common ELISA for the detection of antibruella antibodies in both livestock and humans using recombinant protein G which reacts with immuoglobulins of different species like cow, sheep, goat, swine, and humans has been standardized.

Disease outbreaks investigated during the period

- Deaths in sheep due to hemoglobinuria and diarrhea.
- Kerato -Conjunctivitis outbreak.

AINP-BT

- 677 serum samples collected / received from Karnataka, Madhya Pradesh, Gujarat and Andhra Pradesh were screened for the presence of bluetongue antibodies using indirect sandwich ELISA and 185 samples (27.32%) were positive for anti-BTV antibodies.
- 170 L2 gene sequences of BTV belonging to all the 24 serotypes were downloaded from the NCBI genbank and aligned carefully. Primers were designed and synthesized for use in molecular epidemiology.
- Preliminary molecular epidemiological studies based on clinical samples indicated involvement of serotypes 1 and 2 in bluetongue outbreaks in Karnataka
- Under the Spatial Epidemiology, the task of updating the taluk level digital maps of Karnataka and Tamil Nadu was completed.
- Density maps of sheep and goat population in Karnataka and disease mapping for bluetongue in Karnataka for the past 15 year were completed.

Monitoring of the Leptospirosis burden in livestock and human

- 191 stock cultures from different livestock and human hosts which were isolated in EMJH medium and whose morphological characters were assessed by dark field microscope as spirochetes were taken up in this study.
- Identified 99 *Leptospira* isolates using PCR techniques and differentiated pathogenic and non-pathogenic isolates.
- RpoB gene based phylogenetic analyses of pathogenic isolates showed that the major circulating pathogenic species of leptospira in livestock were *L. borgpetersenii* / *L. interrogans* (58%), *L. kirschneri* (15%), and *L. inadai* subgroup (27%).
- Molecular based antigen detection diagnostic methods are available for the specific identification of leptospira of livestock and humans and for monitoring of pathogenic Leptospirosis in livestock.
- 144 samples were found positive for *Leptospira* by PCR. The rpoB partial gene sequences were amplified from these samples directly, cloned and sequenced and 19 partial rpoB gene sequences were submitted to GenBank database
- Cloning of the partial N-terminal portion of ligB protein coding gene sequences was carried out in pPET 33b vector and characterized and expression study on characterization of recombinant protein is in progress.
- Human / animal samples were screened on request from NIMHANS, RMV Hospital / veterinary college, Bangalore for *Leptospira*.

Sero-epidemiology of *Peste des petits Ruminants* (PPR) in livestock

- 2609 serum samples were collected from cattle, buffaloes and goat in Southern India and screened for PPRV antibodies by competitive ELISA kit.
- Analysis of 2161 bovine serum samples indicated an overall 4.58 % prevalence of PPRV antibody in cattle and buffaloes.
- A total of 685 serum samples (from sheep, goats and cattle) submitted to the Serum Bank were screened for PPRV antibodies by using PPR C-ELISA kit.

Bovine mastitis

- Isolation studies on composite milk samples showed that the most predominant pathogens were *Staphylococcus* spp. (71.70%) followed by *Streptococcus* spp. (14.15%) and *E. coli* (14.15%).
- 173 *S. aureus* isolates were screened for 12 *Staphylococcus* superantigens (enterotoxin and enterotoxin-like genes) and Ser was found in majority of the isolates.
- MLST analysis of *S. uberis* led to the identification of 10 new alleles and 3 unique STs which were designated as ST-439, ST-474 and ST-475 and are available in the *S. uberis* MLST database.
- *S. agalactiae* induced infection revealed significant up-regulation of 7 genes of which four genes viz. GMCSF, CD14, C3 and SAA3 peaked at the very initial course of disease i.e., 2 hours post infection followed by a sharp decline in the fourth hour post infection.
- To investigate the genetic basis for the methicillin resistance in *mecA* negative CoNS isolates screening for *mec* homologue was performed. None of the *mecA* negative isolates harboured *mec* homologue gene suggesting the role of other genetic factor for imparting resistance.
- Investigation of accessory gene regulator (*agr*), a global regulator of the synthesis of many virulence factors in *Staphylococcus aureus*, was carried out in the isolates from bovine milk samples. Majority of the isolates in the present study possessed *agr* I type which has been reported to cause persistent infections by internalizing in the mammary epithelium.
- Expression profile of genes associated with immune response mechanisms in mastitis induced by experimental infection of *S. aureus* (2 strains of t267) and *S. uberis* (ST-439, ST-475) was done by UPL based Real Time PCR.

Classical swine fever and Infectious Bovine Rhinotracheitis

- Seroepidemiology of IBR in Cattle and Buffalo: 4456 serum samples from eleven states were subjected to Avidin Biotin ELISA (PD_ADMAS). It was found that 1494 serum samples were positive for antibodies against BoHV-1. An overall apparent percentage positive was 34.
- Molecular Epidemiology of BoHV-1: Molecular epidemiology of different genomic regions (293bp-gB region, 343bp-gD region, 443bp-gB) indicated involvement of subtype 1.1 in the outbreaks.
- Development of indirect ELISA kit for the detection of antibodies to classical swine fever: 1257 serum samples were subjected to blocking ELISA using commercial kit. It was found that 237 serum samples were positive for CSF antibodies. An overall apparent percentage positive was 19.
- Molecular epidemiology of classical swine fever: Molecular Epidemiology using 5'UTR, E2 and NS5b genomic regions of Classical swine fever virus (CSFV) was done. The results indicated the involvement of subgroups 1.1 and 2.2, with the predominance of subgroup 1.1 in CSFV outbreak in India. Further analysis indicated plausible Chinese origin Indian subgroup 2.2 viruses.

Epidemiology unit

- The NADRES database created during 2004 on Oracle platform, was shifted to MySQL platform and all the data were shifted. District master table has been updated with 640 districts from 609 districts.
- Livestock disease data up to December 2011 have been uploaded into the NADRES software. Ecopathozones for all the major livestock diseases have been prepared.
- Livestock census 2007 data is being converted to a database for epidemiological analysis.
- Archival disease data which was not previously entered in the NADRES database are being entered in the database.
- Disease trends for Haemorrhagic septicaemia and Anthrax have been worked out. Similar studies are being conducted on other important viral, bacterial and parasitic diseases.

INDIAN VETERINARY RESEARCH INSTITUTE, HEBBAL, BANGALORE

The Bangalore Campus of the Indian Veterinary Research Institute, established in 1972 is engaged in the research and development of Foot and Mouth Disease vaccines and has contributed significantly to the FMD control activities in the country.

The control of Foot and Mouth disease is taken up on priority as it is a major disease of livestock having serious economic consequences. The programme is fully funded by the GOI and implemented by the state departments of Animal Husbandry. At present under the national FMD Control Program 221 districts of the country in 8 states and 3 union territories are covered with a target population of 125 million cattle & buffaloes. In addition to this, FMD vaccination is also carried out in the remaining parts of the country under the ASCAD program. The requirement for FMD vaccine at present is about 350 million doses per annum which is expected to increase to about 600 million doses per annum by the time the 12th Plan commences. The states of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Puducherry and Goa are fully covered in the FMDCP now. The major challenge in improving the FMD vaccine is aimed at increasing the duration of immunity, increasing the thermal stability and having purified vaccine for differentiation of infection from vaccination.

Status of Research

1. Development of an adeno virus vectored vaccine has been initiated in July 2010 under USDA-ICAR collaboration with the aim of developing a more effective new generation vaccine.
2. Technology refinement and improvement of the conventional whole virus vaccine to have a Non Structural Protein (NSP) antigen free vaccine as use of this vaccine will help in differentiating vaccinated from infected animals as per the OIE guidelines.
3. Increasing the duration of immunity of the conventional vaccines by trying effective newer adjuvant combinations and antigen payloads. The work carried out during the last one year has given very encouraging results.
4. Development of new generation Parapox vectored vaccine has been initiated during 2011 which will help in both longer duration of immunity and also NSP free. This approach will also help in trying alternate routes of vaccination for better immune response and improving the thermo stability.
5. A baculovirus expressed 3ABC antigen ELISA test has been developed and validated for screening of the NSP antibodies to differentiate infection from vaccination. This cost effective kit will be very useful for the country for sero surveillance work.

6. Providing technical backstopping to DADF, GOI for having an effective FMD vaccine quality control mechanism for the country and the SAARC region as it is very important for the national control program on FMD. At this campus we have all the required infrastructure and expertise in this area and the work on testing of the vaccine sent by DADF is already undertaken from January 2012.
7. Public Private Partnership initiative to scale up the FMD vaccine production by having a large plant at our Yelahanka facility is initiated and expected to be finalized soon by ICAR.

NATIONAL DAIRY RESEARCH INSTITUTE SOUTHERN REGIONAL STATION, BANGALORE

Highlights of research achievements

- Molecular characterization of BoLA-DRB3.2 alleles in 107 DNA samples were screened in Malnad Gidda cattle. Out of the 98 Deoni animals screened, a total of 34 BoLA-DRB3.2 alleles were identified. Four novel alleles namely DBR3*caf, *eaf, *abb, *pad with each having the frequency of 0.7% have been observed in this breed.
- Digestion of the PCR product with *Rsa* I Restriction enzyme revealed three patterns in all the samples signifying that Prolactin gene have *Rsa* I site in Deoni cattle.
- Production performance of graded HF and HF crosses belonging to 60 dairy farmers including five commercial dairy farmers from Bangalore, Kolar and adjoining districts was carried out. The study also included evaluation of performances of graded HFs in 14 commercial herds of Punjab where better housing and feeding inputs were provided.
- Whey drink prepared from both protein and lactose hydrolyzed whey with 8% sugar, 1% starch and 4% mango pulp was acceptable for the consumers.
- An attempt was made to improve the textural stability of buttermilk drinks through homogenization of the milk used and addition of stabilizers. Thermization and carbonation of buttermilk drinks helped to extend their shelf-life.
- The kinetics of colour changes in *gulabjamun* during deep-fat frying, including order of reaction, reaction rate constants and temperature dependence is important for maximizing quality and minimizing losses.
- Malnad Gidda showed higher cellular response to FMDV antigen and sub viral practices than Deoni breed.
- 439 base pair segments of the Hsp 70 gene promoter region was amplified using the DNA extracted by high salt method for Deoni, Holstein Friesian Crossbred cattle and Holstein Friesian cattle using primers HSP-Pro749F and HSP-Pro 1268R.
- *In vitro* gas production (IVGP) on 27 concentrates feed stuffs, 3 roughages, 12 concentrate mixtures and 4 complete roughage based diets were measured and subjected to first order gas kinetic models to determine asymptote of gas production (Y_{α}), half time of Y_{Max} , lag time (λ) of initiation of fermentation and rate constant (k).
- The method of preparation of *khoa-jalebi* was standardized. The product was evaluated for sensory acceptance. *khoa-jalebi* had a shelf-life of 4 – 6 days in low barrier materials and 6 – 10 days in high barrier materials at 30°C.
- A method for the preparation of ready to reconstitute payasam dry mix incorporating ground green gram dhal and poppy seeds, and skim milk powder was standardized and a dry product containing either sucrose (50%) or sucralose (3200 ppm) was prepared. A ready-to-reconstitute malted foxtail millet – milk solids dry mix using foxtail millet malt powder, sugar and skim milk powder was standardized.

- Carrot *halwa* and *Kashi halwa* were evaluated for their microbial quality. The microbiological *halwa* prepared by retort processing showed that the bacterial count in fresh samples was less than 10/g and the count did not increase during 4 weeks of storages at 37 °C.

Education and training

- Ph. D Programmes are being offered in the disciplines of Dairy Technology, Dairy Chemistry, Animal Genetics & Breeding, Livestock Production and Management and Dairy Economics.
- In addition to conducting M. Tech Programme in Dairy Technology, guidance is being provided to the PG students in the disciplines of Dairy Chemistry, Dairy Engineering, Animal Genetics and Breeding, Livestock Production and Management, Animal Nutrition and Dairy Extension for carrying out their dissertation work.
- Short term Training Programmes are being imparted in Processing, Quality Assurance, Dairy Production and Extension for students, dairy farmers / entrepreneurs and personnel from Co-operative Federations and Private organizations.

Awareness creation and training cum demonstration on diagnosis and control of subclinical mastitis

Programmes under the NABARD sponsored research project were undertaken on detection and control of subclinical mastitis under field conditions. Efforts made towards achieving quality milk production by educating the dairy farmers through training and demonstration benefitted more than 500 farmers. The training cum demonstration programmes on detection of subclinical mastitis in the milking cows by using electrical conductivity meter, California Mastitis Test kit and digital somatic cell counter were arranged both on campus and off campus *i.e.* at farmers' door step. The efforts resulted in awareness creation about subclinical mastitis and they have started to implement the detection and control of subclinical mastitis. After our demonstration, Karnataka Milk Federation (KMF) both in Bangalore and Kolar districts has initiated steps to control subclinical mastitis at their collection centres. Thus clearly the efforts made by the NDRI SRS team have helped in quality improvement of milk production in the region.

CENTRAL SHEEP & WOOL RESEARCH INSTITUTE SOUTHERN REGIONAL RESEARCH CENTRE, MANNAVANUR

SRRC of CSWRI deals with sheep, broiler rabbits and wool. The centre with 400 Bharat Merino sheep, 600 broiler rabbits had recorded very good production / reproduction traits. Supplied these two precious species to farmers for breeding purposes and established a number of sheep and rabbit farms. Bharat Merino is the pride of CSWRI, now available at SRRC only. The centre provided consultancy to the existing sheep and rabbit farms and conducted training programs for the farmers. It has popularized broiler rabbit farming in South India. About 2500 farmers / stake holders are in constant touch with SRRC.

CHAPTER IX

PROGRESS OF RESEARCH IN FISHERIES

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

- An open water cage fish farm of 225 cages was established in the open Kayal adjacent to Regional Agricultural Research Station, Kumarakom campus. Cage farming of Karimeen and endemic fishes is undertaken by involving women Self Help Groups.
- An aquarium centre for endemic fishes and a fish feed unit has been commissioned
- Polyculture of mud crabs, *Scylla serrata* and *S. tranquebarica* along with brackish water fish species enabled to achieve better production from wet land farming system.

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, KOCHI

- Exploitation level of various commercially important species and optimum fleet sizes for various states were estimated. Management advisories for various fisheries were developed.
- Marine policy brief for Kerala incorporating various management options for the Kerala Marine Fishery was released.
- Pop-up X-tags, which provide fisheries-independent measure of the straight-line distance traveled from the point of tagging, was deployed on yellowfin tuna (*Thunnus albacares*) for the first time in Indian waters by the Institute. With this achievement, India joins the elite group of countries engaged in satellite tracking of yellowfin tuna.
- Increasing the cod-end mesh size of trawl nets to 35 mm, usage of bycatch reduction devices and prohibition of mini trawling like thallumadi in coastal nursery areas are the rapid remedial measures advocated to reduce Low Value Bycatch in trawling operations.
- The trophic model mass balanced and fitted for marine fisheries management in Gulf of Mannar signified that the net primary production, net system production and total biomass are much higher in GoM compared to northwest coast of India. Positive correlation was evident between chlorophyll c concentration and mackerel landing in Kerala, primary productivity and sardine catches, dissolved oxygen content of subsurface waters and mackerel landing at Tuticorin.
- Stock assessment shows that the coastal tuna is exploited very close to MSY level but the oceanic tuna potential is currently more than 75% unexplored, giving scope for considerable enhancement and expansion in terms of capture.
- Fifteen exploratory surveys and jigging cruises were undertaken in a fishing trawler MV Titanic (20 m LOA) from 100 m to 4,000 m along the Eastern and Central Arabian Sea. New spawning grounds of oceanic squid *Sthenoteuthis oualaniensis* were located in the Arabian Sea. Myctophid fishery by deep sea shrimp trawlers constituted 840 to 1,680 kg/trip.
- The 'Cadalmin™ Varna' series of ornamental fish feeds standardised and refined in terms of packaging and colouring with natural colour sources was yet another striking performance in product development by CMFRI.
- In the marine bioprospecting area, the development of another significantly remarkable product, the green mussel extract 'Cadalmin™ GMe' is designed to find a unique way to shelf-life stability and anti-inflammatory principles.

- Successful broodstock development and seed production of marine finfishes like Cobia (*Rachycentron canadum*) and Pompano (*Trachinotus blochii*) opened a new chapter for economically valuable marine fish seed production and farming. Hatchery technology for *Etroplus suratensis*, a popular fish in Kerala, was developed and technology was extended to potential farmers.
- Open sea cage farming demonstrations of Seabass, Cobia, Pomapno and lobster at various maritime states of the country gave good harvests and have boosted the prospects of cage farming in the country. Growth of grey mullet and pearl spot (Karimeen) in captivity in brackish water environment off Cochin has opened up yet another avenue for selecting candidate species for cage culture.
- Scaling-up of hatchery production of *Amphiprion percula*, *A. sebae*, *A. frenatus*, *Premnas biaculatus*, *Chrysiptera cyanea*, *Pomacentrus caeruleus* and *Dascyllus aruanus* were achieved.
- Functional feeds were developed and nutritional trials were made for open sea cage farming, ornamental fishes and lobsters.
- Underwater surveys conducted along the south-west coast to assess the status of coral cover and biodiversity showed the coral growth patchy and sparsely distributed. Fish assemblages and sponges associated with coral reefs were studied using visual census method.
- Nursery of mangrove plants was developed at Moothakunnam, Ernakulam and Kuduroli in Dakshina Kannada through participatory community based Marine Ecosystem Restoration Programme.
- *Perkinsus olseni*, an OIE listed protozoan parasite with a prevalence of 100 % was found to be one of the major reasons for the decline of the natural pearl oyster beds (*Pinctada fucata*) along the Tuticorin coast.
- Bar coding of two species of tunas namely *Sarda orientalis* and *Thunnus tonggol* was carried out through PCR amplification of CO-1 gene followed by sequencing.
- Investigations related to climate change signified that the increasing Coastal Upwelling Index and the prevailing high concentration of chlorophyll a during monsoon sustained an increased catch of oil sardine.
- The distribution of fish species with more rapid turnover of generations may show the most rapid demographic responses to temperature changes.
- With the northern latitudes becoming warmer, the oil sardine, which is essentially a tropical species, is able to establish itself in the new territories and contribute to the fisheries along the northwest and northeast coasts of India.
- The socio-economic scenario of the marine fisheries showed discernible changes during the period. The gross revenue from landings both at landing centre and retail centre increased by about 15 per cent to Rs. 17,753 crores and Rs. 28,511 crores respectively.
- CMFRI launched an innovative programme 'Fish Watch'. Fish landing figures and landing centre price range of important resources at six major fishing harbours of the country are being published as "Fish watch" in CMFRI web site. These figures are updated at 1600 hours on working days.
- Marine Fisheries Census - 2010 was successfully completed generating detailed information on the coastal villages and fisher folk.
- Launching of CMFRI Trademark: the CMFRI has officially registered a trademark entitled 'CADALMIN' for the products and services of the institute.

CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE, CHENNAI

Shrimp farming

- Experiments to evaluate the effect of formulated maturation diet on spermatophore quality in male *P. monodon* indicated the possibility of partial replacement of natural diet with formulated diet.
- The presence of cortical rods and cortical rod protein is the biomarker for the final oocyte maturation in penaeid shrimps.
- A 45-days indoor experiment with juveniles and adults of *P. monodon* on the use of molasses as supplementary carbon source to convert excreted and unused nitrogen into the microbial biomass showed that treatment with molasses for Biofloc development had additional body weight gain of 30 % and 12.5 % in juveniles and adults respectively.
- The efficiency of SFDWTS is being monitored in six tiger shrimp culture ponds. It was observed that the TSS reduced considerably in 48 hour retention period.

Diversification

- Unlike conventional breeding of cobia reared in open sea cages, broodstock of cobia were maintained in earthen ponds which attained maturity and successfully spawned.
- For the first time in India, successful breeding of brackishwater ornamental fish Scat *Scatophagus argus* under controlled condition was achieved and the protocols were standardized.
- Comparative evaluation of the breeding performance of Asian seabass of domesticated and freshly collected broodstock indicated better performance of fresh stock compared to domesticated stock. From single spawning 0.08 - 6.0 lakhs and 2.0 - 3.6 lakhs hatchlings of seabass could be obtained from the domesticated and new stocks respectively.
- Nursery rearing of Asian seabass in farmer's pond using net cage hapas was followed up in fresh water pond, where the production cost was about Rs.6/pc from fry to fingerling size. Nursery rearing trials in Tamil Nadu and Karnataka demonstrated a survival rate of 58 to 67%.
- Three ponds each with 1 ha area were stocked with *Mugil cephalus*, *Etroplus suratensis* and *Penaeus monodon* at 10,000, 1000 and 10,000/ha, respectively. Shrimp was harvested after 150 days with production of 50-55 kg/ha. *M. cephalus* and *E. suratensis* attained 500 and 100 g MBW, respectively after 300 days.
- Four breeding trials on Asian seabass were carried out, two by natural breeding and two by hormonal administration. The ornamental fish Scat was bred three times by hormonal treatment and successful spawning was attained.
- For the first time, using land based broodstock, four breeding trials were conducted on Cobia and in two trials successful spawning and fertilization was noticed. Larval rearing was completed from one spawning.
- The techno-economic viability of Asian seabass farming was demonstrated in Tamil Nadu. Under monoculture, the fish attained size ranging from 200 g to 1.2 kg in 7 months with formulated feed. Under polyculture system in a mangrove pond, seabass attained size ranging from 500 g to 1.2 kg with formulated feed and mud crab attained size ranging from 300 g to 850 g with forage fishes.
- In polyculture of tiger shrimp, grey mullet and pearlspot, in 150 DOC, tiger shrimp reached average size of 42 g. Grey mullet and pearlspot attained final size of 570 g and 100 g respectively in 300 DOC. Total production achieved was 2520 kg/ha.

- Breeding trials on brackish water ornamental fish *Monodactylus argenteus* was successfully carried out using pond reared broodstock.

Environment Management

- The efficiency of aerators used in different shrimp farming systems varying in stocking density was worked out. The aeration requirement per kg of production varies from 1.28 to 3.23 HP
- Physico-chemical and biological parameters were monitored periodically in two *P. vannamei* culture ponds.
- Harvested pond bottom sediments from *P. monodon* and *L. vannamei* culture ponds in Andhra Pradesh and Tamil Nadu were collected and analysed for organic C and total nitrogen and phosphorus.
- Microbial flora from biofilm onto the substrates was characterised which revealed mostly gram negative organisms followed by gram positive organisms. Treatment with tapioca powder was found to be more efficient for bioremediation when compared to the use of substrate alone.

Disease Management

- With a view to study the immunogenicity of bacterial antigens, bacterial cell surface antigens, Outer Membrane Proteins (OMP), Extracellular proteins (ECP) and Lipopolysaccharides (LPS) were isolated from pathogenic *Vibrio anguillarum*.
- Recombinant chitinase was tested for its antifungal activity and the purified recombinant chitinase showed antifungal activity against plant pathogenic fungi *Curvulnaria* sp.
- Isochorismate Isomerase gene responsible for encoding proteins for resistance against a variety of pathogenic bacteria was amplified from *Vibrio alginolyticus* and cloned into pET32A vector system and transformed into *E. coli* DH5α.
- The gene for Azurin which has antiretroviral and antimalarial activities and also exerts cytostatic and cytotoxic (apoptotic) effects with no apparent activity on normal cells was amplified from *Vibrio alginolyticus*.
- The complete ORF of azurin gene was amplified from *Vibrio alginolyticus*. The resulting 440bp PCR purified fragments were cloned into pET32A vector system and transformed into *E. coli* DH5α. The recombinant plasmid was transformed into *E. coli* BL21 expression host and was over expressed by induction with 1mM IPTG.
- The complete ORF of *huvA* (2100bp), *OMP26la* (780bp) and *OMPU* (1050bp) were amplified from pathogenic *V. anguillarum*.
- A diagnostic kit for LSNV has been developed and is being validated.
- Outer membrane protein (OMP) has been isolated from pathogenic *V. anguillarum* and being tested against *V. anguillarum* infection in Asian seabass.
- LSNV from tissue homogenates tested for adaptation in shrimp primary hemocyte culture was found negative by nested PCR after three passages.
- Using the WSSV proteins baits and expressing these in yeast, attempt was made to observe their effect on the survival of shrimp larvae against WSSV infection. When the larvae were either fed with yeast directly or through artemia, bait proteins had higher survival rate from 72 hours of post infection till 96 hours. The survival was significantly different from that of normal control and vector control.

Nutrition

- Diet with 27% crude protein (CP) and 9% lipid promoted better growth of *Mugil cephalus* fry.

- Nutrients and ingredients for development of cost effective feeds for pearlspot fry rearing were optimized. The results indicated that 40% protein is required for faster growth of the fry.
- Feeding trials indicated that 10% MBM (meat and bone meal) can be used in Asian seabass grow-out feeds without compromising growth and FCR.
- Corn gluten meal (CGM) can be included up to 10% in the diet of seabass without affecting growth and FCR.
- 8% lipid and 2% lecithin in the diet produced better growth and good feed conversion ratio (FCR) for tiger shrimp at low salinity.
- Studies with feeds prepared using locally available ingredients on wild collected *Mugil cephalus* fry, acclimatized to pellet feed indicated that 27% protein with 9 % lipid showed better growth performance and lower FCR than the other combination groups.
- Chicken waste meal can be incorporated up to 5% without compromising the growth of Asian seabass, *Lates calcarifer*, FCR and survival.
- Heat treatment (700 C for overnight) could reduce about 40% glucosinolate level in mustard oil cake and water treatment could reduce about 31% glucosinolate.

Genetics and Biotechnology

- Studies on up-regulation of genes in salinity related stress in *P. monodon* revealed that both carbonic anhydrase and sodium potassium ATPase genes were up-regulated in the shrimp under low salinity (3ppt) stress conditions.
- Filed a patent application entitled 'Development of an assay and kit for molecular screening of Betanodavirus by nested reverse transcription polymerase chain reaction (nested RT-PCR)' (Patent application No. 347/DEL/2011 Dt. 11th February 2011).

Extension and Marketing

- Analysis of total marine production export data (MPEDA) in terms of quantity, value and price for the period January 1995 to March 2010 showed highest growth over previous year during 2000 followed by 2006.
- Time series models were developed for quantity (t) and value (Rs.) of total marine exports from India by using monthly exports data from 1995 to 2010.
- An assessment of jelly fish processing was made among 50 women crab farmers in a village near Pulicat in Tiruvallur Dist. This avocation was taken up by these farmers as an alternative livelihood during the lean season for crab fattening.
- A weighted Entrepreneurship Motivation Index was prepared to measure the entrepreneurship motivation of fisheries graduates in Tamil Nadu and found that they exhibited moderate entrepreneurship motivation with an EMI score of 79%.
- A survey on Micro Brackishwater Analysis Kit (MBAK) revealed that MBAK has the slight edge over other kits in terms of price and number of parameter being analysed.

Extension and Economics

- A market survey on demand for white shrimps in TN & AP was completed and the price band of Rs.250 to 320 was observed for white shrimp while farmers reported Rs.220 as the price offered by exporters for 40 - 50 counts. If mini cold storage facilities are created supporting slow release of harvest, domestic demand could be tapped by vannamei producers.
- In a case study the farmer group has identified the critical conflict points (CCP) and developed its own novel strategies to tackle those CCPs.

Commercialization of technology

- pH & DO Kit
- Asian seabass seed production technology-
- Extension of CIBA shrimp feed technology

Patents

- Patent filed for development of an assay and kit for molecular screening of betanodavirus by nested reverse transcription Polymerase Chain Reaction (nested rt-PCR)
- Amendment has been made in the existing patent application "Immobilizing matrix from bagasse for bacterial biomass and a process for preparation thereof" (patent application number:- 633/CHE/2006)

Copyright

- Software for the estimation of carrying capacity of water body for shrimp farming version 1.0

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY, KOCHI

- The performance of two preservative treated canoes and three FRP sheathed rubber wood canoes were satisfactory after eight years of service in long term trials.
- Coconut panels treated with Copper Chrome Arsenic (CCA) showed better resistance to termite than chitosan, neem oil and cashew nut shell liquid (CSNL) treatment.
- Lack of infrastructure like OBM servicing, vessel dry docking and bunkering facility for the vessels at the jetty and lack of policy for sports fishing were observed to be major problems in the recreational fishing in marine sector.
- Experimental trials using short body shrimp trawls showed significant reduction in the mean bycatch in comparison with the conventional shrimp trawls of the same size.
- Introduction of large mesh purse seines has led to the revival of small mechanized purse seine fishery along the Cochin coast.
- Total bycatch discards of deep sea shrimp trawlers at Kollam has been estimated as 11488 t. Myctophid contribution was about 3676 t with a catch rate of 19.87/kg
- Designed and developed a multi seam bottom trawl for demersal fishing off east coast.
- Field tested semi circular fish eye and square mesh panels for juvenile fish exclusion.
- Developed foldable fish and prawn traps for reservoir fishery.
- Comparative fishing operations carried out in the PFZ and non-PFZ areas along the Gujarat coast indicated the average CPUE as 33.01/kg and 30.15/kg for PFZ and non-PFZ areas, respectively.
- *Listeria monocytogenes* was detected in 2.2% of the 89 samples comprising of 70 fish samples and 19 fishery environmental samples (9 ice and 10 mud and sands) and serogroups 1 and 4 were identified. This is the first report of isolation of *L. monocytogenes* from seafoods from Kerala.
- Pathogenic *Vibrio parahaemolyticus* was present in 21% of the 78 seafood samples collected from retail markets in Ernakulam, Kottayam and Alappuzha districts in Kerala. 11.6% of the 198 strains of *V. parahaemolyticus* strains isolated possessed TDH gene and 3.9% isolates possessed pandemic marker ORF8 sequence. This is the first report of isolation of *V. parahaemolyticus* harboring pandemic marker from sea foods from Kerala.

- One methicillin resistant *Staphylococcus aureus* (MRSA) strain, one *Yersinia enterocolitica* biotype 1A strain, three *Shigelladysenteriae*, *S. boydii* and *S. flexneri* strains and three *Vibrio choleare* O1 biovar El Tor strains were detected from 84 seafood samples analyzed from retail markets in Ernakulam, Kottayam and Alappuzha districts. However *E. coli* O157:H7 could not be detected in any of the 45 seafood samples analyzed.
- Benzalkoniumchloride at 0.1% concentration was able to reduce the *Listeria* population in biofilm by 2.25 log₁₀ value, while 0.2% completely destroyed the *Listeria* population in biofilm. 20 ppm chlorine was sufficient to completely destroy the *Listeria* population in the biofilm.
- Bioprospecting of marine bacteria showed that of the 146 bacterial isolates, *Oceanobacillus iheyensis* and *Paenibacillus* strain exhibited high chitinolytic activity. *Bacillus subtilis*, *Bacillus pumilus* and *Paenibacillus polymyxa* were identified as the most promising alkaline protease producing bacteria. The activity of the purified alkaline protease enzyme from *B. subtilis* SQ12 was 545, 710, 918, 890, 645 U/ml respectively at pH 8, 9, 10, 11 & 12 and the activity was three times higher as compared to the crude enzymes.
- Sorbitol dehydrogenase gene, controlling the production of an enzyme sorbitol dehydrogenase which catalyses the conversion of fructose to sorbitol and which can act as an osmo-protectant in bacteria was PCR amplified from *Oceanobacillus iheyensis* and heterologously expressed in *E. coli*.
- *Oceanobacillus iheyensis* whole Transcriptome Analysis was carried out using SOLiD 3 plus sequencer under 0.4 OD and 1.0 OD growth conditions at 7.5% growth conditions. There were 349 genes that were upregulated belonging to 8 key pathways and 499 genes that were downregulated belonging to 3 key pathways.
- Among mechanized boat operators in Nagapattinam and Cuddalore districts of Tamil Nadu, use of electronic equipments, adequate ice, large mesh trawls, steel trawlers and improved trawl designs were adopted. Among the motorized craft operators (9 m LOA FRP), use of 11 hp outboard engines and improved gill nets were observed.
- The motorized FRP craft owners in Kannur and Thiruvananthapuram districts in Kerala had operated 8.5 m LOA FRP crafts with an average investment of Rs.3.3 lakhs towards the cost of craft, engine and fishing nets. The net profit of operating 8.5 m FRP crafts varied from Rs.50,000 to Rs.5,78,000/- with an average of Rs. 1.98 lakhs per year.
- Based on two shifts per day, the installed capacity in Indian fish processing sector was estimated at 17,72,075 tonnes annually. The capacity utilization in the processing units was 39.4% in the West Coast compared to 20.5% in the East coast. Low percentage of capacity utilization in the East coast was mainly due to stagnation in the aquaculture sector.
- The average waste generation through cephalopod processing was found to be 25.49%. Around 40,000 tonnes of cephalopod products were exported from Kochi port annually amounting to a generation of 12,500 tonnes of waste.
- Marine fish species that have higher consumer preference viz., seer (*Scomberomorus guttatus*) and silver pomfret (*Pampus argenteus*) and fish with lower consumer preference viz., flying fish (*Cypselurus comatus*) were procured from Fishing Harbour, Visakhapatnam and analyzed for microbiological quality parameters (TPC, *E. coli* and *Staphylococci*), biochemical quality parameters (TVBN, PV) and proximate composition (moisture, protein, fat).
- 'Chellanam Fresh'- the Community Based Processing Unit envisaged under the NAIP was initiated in Chellanam with the collaboration of the Chellanam-Kandakkadavu Fishermen Welfare Development Co-operative Society, a core partner of the project.

- Disinfection efficiencies of different disinfectants (Iodophore, Huwasan, H₂O₂, Chloramine and bleach liquor) were tested with different strains of *V. parahaemolyticus*. Iodophore was found to be having more action compared to other disinfectants tested.
- Species-specific and organ-specific bioaccumulation of cadmium in squid was observed.
- Studies on solar disinfection of water have shown that almost all non-spore forming pathogenic bacteria can be eliminated within 3 hours. Initiated studies on effect of containers viz. PET bottle, glass bottle etc.
- Pathogenic *E. coli* (O157) could survive 11 months in cold storage condition (-18°C) on fish substratum after freezing at -40°C (90 minutes).
- Studied the total bacterial load of 12 different food contact surfaces of a seafood processing factory immediately before the commencement of work and it was found to be higher than the permissible limit. Its RLU varied from 2 to 7683.
- Inoculation studies have shown that pathogenic *Vibrio parahaemolyticus* i.e. O3:K6 serotype could survive freezing at -40°C and survive upto four weeks in cold storage (-18°C).
- Developed short time marinated *Pangasianodon* fillets with a shelf life of 21 days in chilled conditions.
- A gas concentration of 80% CO₂ and 20% O₂ was found most suitable for modified atmosphere packaging of *Pangasianodon hypophthalmus* steaks packed in polyester/polythene film which extended the shelf life to 24 days compared to 16 days for air packed samples.
- Combination of vacuum packaging and microwave processing and quick chilling on shelf life of catfish (*P. hypophthalmus*) fillet gave an extended shelf life of 19 days compared to 9 days for conventional air packed samples.
- Fish protein hydrolysate (FPH) from the meat of catfish, *P. hypophthalmus* by the enzyme alkaline protease alcalase gave a yield of FPH that ranged from 7-10% at different enzyme substrate concentrations. FPH from catfish had excellent functional and antioxidant properties.
- High pressure processing at 200 MPa was found to extend the shelf life of vacuum packed yellowfin tuna chunks during storage at 1-2 °C when compared untreated samples.
- Ready to serve thermal processed fish curry in Mughalai style using Mahseer (*T. khudree*) was found to be acceptable for 12 months at ambient temperature storage.
- 18.5 m CIFT-SPTS has been released for the benefit of small scale mechanized sector as an alternative to shrimp trawling and to reduce the impact of trawling on the ecosystem.
- Results of the preliminary trials of 27 m short body shrimp trawl with large horizontal spread showed about 30% reduction in bycatch.
- Field trials with 44.8 m cut-away top belly shrimp trawl showed considerable reduction in bycatch landings and increase in the landings of target catch.
- The technology of large mesh purse seine has been released and popularized among the boat owners in Cochin.
- *V. choleae* O1 biovar El Tor Ogawa was detected in three out of 148 seafood samples tested and molecular characterization revealed presence of tcpA, ctx, zot, ace and tox genes.

- *L. monocytogenes* isolates from freshwater fish and ice samples harboured all the virulent genes β -hemolysin (hly), plcA, iap (Infection associated protein), mpl (metalloprotease), prfA (The regulatory gene) and actA.
- *Campylobacter jejuni* was detected in one out of 23 fish samples.
- *Escherichia coli* O157:H7 was not detected in 54 samples including 15 water samples (and 39 fish samples). Fifty seven percent of the samples harbored bfpA gene specific for enteropathogenic *E. coli*.
- Studies on efficacy of different concentrations of H_2O_2 (0.1, 0.2 and 0.3 %) on Biofilm formed by enteropathogenic (EPEC) *Escherichia coli* on glass slide revealed that all three concentrations of H_2O_2 used can reduce the EPEC *E. coli* population in biofilm after 5 min exposure by 1.939, 3.324 and 3.635 Log10cfu/cm², respectively from a concentration of 7.539 Log10cfu/cm².
- Studies on bacterial flora associated farmed catfish (*Pangasianodon hypophthalmus*) and farmed rainbow trout (*Oncorhynchus mykiss*) showed that the microflora was dominated by *Pseudomonas* (*P. fluorescens* and *P. aureofaciens*), *Aeromonas*, *Enterobacteriaceae* (belonging to the genera *Proteus*, *Providencia*, *Citrobacter* and *Morganella*), *Moraxella*, *Acinetobacter* and *Flavobacterium*.
- Studies on production of chitinase by *Vibrio harveyi* and *V. alginolyticus* revealed that *V. alginolyticus* showed greater chitinase activity (134 U/L after 1 day) than *V. harveyi* (84 U/L after 2 days).
- Studies on lab scale fermentation of alkaline protease from marine bacteria, *Bacillus subtilis* SQ9 in a three litre Lab scale bioreactor using fish waste based media formulation showed an enzyme activity of 240 U/ml after 24 h whereas, after 48 h it was recorded at 410 U/ml for the crude enzyme.
- West Bengal contributed maximum manpower in fishing activity followed by Kerala.
- A group was mobilized at Munambam and developed as a pilot level semi commercial model for production of value added fish products.
- A perusal of the export value realized shows that there is a decreasing trend in the actual unit value realization. Though in rupee terms the unit value realized has increased from Rs. 118.17 in 1995-96 to Rs. 147.86 in 2003-04, in \$ terms it has actually fallen from 3.75 to 3.02 during 2006-07.
- The revealed comparative advantage (RCA) of shrimp exports to the US from India was 0.44 during 2006 indicating India has no comparative advantage in exporting shrimp to US.
- Three resource specific maps were developed on Chellanam Panchayat on infrastructure and demographic characteristics.
- On food safety, 16 fish varieties have been analysed for microbiological parameters; presence of coagulase positive *Staphylococcus aureus* in high numbers in some of the samples indicated poor personal hygiene by the fish handlers.
- *Listeria monocytogenes* (ATCC-13932) could form biofilm with cell density of 1.1x10⁵ CFU/Cm² on glass surface within six days.
- *Salmonella enteritica* could survive 12 hours of cumulative exposure to sun drying in anchovy *Stolephorus commerson*.
- Nitrosochloramphenicol and dichloroacetamide metabolites formed from chloramphenicol are present in shrimp tissues even after 21 days of withdrawal.

- A differential bioaccumulation pattern of cadmium was observed in various species of Squid. Tissue specific analysis revealed significantly higher accumulation in ink gland, tentacles and digestive gland than the edible muscle portion.
- Standardised process conditions for freeze dried fish balls from the mince of snapper (*P. multidentatus*) by incorporating spices viz., curry leaf, mint, turmeric, ginger, garlic and pepper. A combination of spices had a synergistic effect against oxidation and enhanced the taste of the balls.
- The effect of bleaching time and the concentration of bleaching agent H₂O₂ on % yield and functional properties of gelatin from Cuttle Fish Skin Waste was evaluated and it was found that bleaching and treatment time had a significant effect.
- Developed silage based aquaculture feed incorporated with chitin and chitosan. The stability and durability of the feed was significantly improved whereas leaching of proteins was reduced by the addition of chitin and chitosan.
- Tuna (*T. albacares*) skin gelatin was Type B gelatin with a yield of 15% from the skin. The gel strength was 310 Bloom which was better than that of bovine gelatin. It had a viscosity of 7.77 cP, melting point of 28° C and good functional properties.
- The biochemical quality changes during fermentation of shell waste of deep sea prawn showed that 10 days fermentation resulted in maximum protein hydrolysis.
- The physiochemical properties of chitosan - LDPE films was found to have good barrier and mechanical properties when compared to chitosan- LLDPE films

CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE, BENGALURU

- *Puntius pulchellus*, a peninsular fish species, which was adapted to culture conditions earlier, was bred in captivity for the first time. This is expected to help both in conservation of this threatened species and its addition to the culture basket.
- In polyculture studies of *P. pulchellus* with IMC, it was observed that both pulchellus and catla benefited by the polyculture, recording higher length and weight gains than when grown in monoculture. Polyculture studies with Rohu and pulchellus are nearing completion.
- Specimens of *Puntius carnaticus*, a uniquely peninsular carp species (also the State fish of Karnataka) and *P. kolus* have been collected from the wild and successfully adapted to culture ponds. Male specimens of *P. carnaticus* have already achieved sexual maturity as shown by exudation of milt.
- Problems of poor spawning and hatching of carps due to high levels of alkalinity in the ground water (> 300ppm) have been overcome in two different ways; firstly by dilution of the groundwater with stored pond water and harvested rainwater.
- Ectoparasite infection in carps by *Lernaea cypernaceae* could be controlled by administration of the drug Doramectin @1 mg/kg b.w. through feed.
- *Puntius carnaticus*, *P. pulchellus*, *P. kolus* and *Tor khudree* infected with the ectoparasite *Argulus* showed all the three *Puntius* spp to be highly susceptible to argulus infection, but *T. khudree* appeared to be quite resistant. A key for identification of *Argulus* to species level has been developed and presence of two distinct species of *Argulus* in Indian waters, viz., *A. siamensis* and *A. japonicus* confirmed.
- Preparation of pelleted fish feed on farm with locally available feed ingredients was demonstrated at four places in Karnataka to more than 200 farmers. Fingerlings of *L. fimbriatus* were stocked in 6 farmers' tanks of Chikkaballapur district under polyculture conditions and promising growth observed in three tanks.

- Samples of IMC (Wild and Cultured) were collected from different places in Karnataka and subjected to proximate composition and heavy metal analysis. Consolidated report for samples collected throughout the country is under compilation.
- Nutrient dense diets of egg-yolk-spirulina gave superior growth than plankton diets when common carp spawn were reared at higher than normal stocking densities (30 vs. 10 mil/ha), but survivals were higher in plankton fed spawn.

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE REGIONAL CENTRE BENGALURU

Multi-location trials on improving fish yields in small reservoirs in different agro-climatic zones

- Mallaghatta reservoir (Area at FRL: 630.4 ha, Mean depth: 2.9 m, and C/A ratio: 9.13), under Cauvery river basin of Karnataka, is found productive. The salient limnological parameters are (annual mean): conductivity of water: 475.0 $\mu\text{S}/\text{cm}$, Secchi depth (low inorganic turbidity): 94.8 cm, chlorophyll 'a': 40.7 $\mu\text{g}/\text{l}$ and gross primary production: 2.63 g C/ m^2/d).
- The mean stocking density of fish seed (around 4.0 cm) during 2008 - 11 followed by the lessee society was 1044 Nos./ha/year. The stocked carps contributed to 47% to the commercial catches. The CPUE was a high of 15.6 kg. The estimated fish yield was 62.7 kg/ha/year vis-à-vis the potential yield of 200 kg/ha/year. To achieve this, we recommended
 - Stocking rate of 425 Nos./ha/year of advanced fingerlings
 - Stocking of *C. mrigal* in addition to catla and rohu is recommended.
 - Stocking of grass carp to harness the rich macrophytes resource
 - Pen culture for raising advanced fingerlings may be practiced as the reservoir is ideally suitable.
 - To promote species native to Cauvery river basin; stocking of *L. fimbriatus*, *L. kontius*, *G. dubius* and *P. carnaticus* are recommended.
 - Exploitation of minor cyprinids, not done now, to be done in summer.

Characterization of fishery and population trends using acoustics and experimental fishing

- Studies conducted in Kelavarappalli reservoir, Krishnagiri District, Tamil Nadu indicated over-exploitation of fish stocks. A reduction in fishing effort from 8000 coracle units to 6750 units would help in sustaining fisheries. Closed fishing in September and February would help in reducing recruitment overfishing; a food web model on this reservoir ecosystem was built and the mixed trophic impact studies showed that African catfishes are detrimental for the ecosystem.
- A mass balance model of Karapuzha Reservoir ecosystem in Wayanad district of Kerala was developed. Food web interactions revealed that stocking of Gangetic carps did not negatively impact the endemic species in reservoir ecosystem. The reservoir may be stocked with Indian Major Carps as they are is not detrimental to the ecosystem.
- Acoustic surveys conducted at different zones in Kelavarapalli reservoir revealed a number of fish detections. The experiments proved that a non-invasive procedure using hydro-acoustics could be used in reservoirs for faster biomass assessment without destroying the fish fauna. Potential fishery zones in this reservoir were identified using hydroacoustic survey.

Development of models for fish yield estimation in reservoirs

- ❖ Estimated the relationship of fish yield with area and mean depth for the reservoirs of Tamil Nadu. Models were developed for fish yield estimation based on the size and productivity of the reservoirs.
- ❖ A modified Verhulst-Schaffer model was tried to estimate sustainable fishery exploitation levels in stocked reservoirs. A bio-economic model was developed to estimate reference points such as Maximum Sustainable Yield and Maximum Economic Yield.

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE RESEARCH CENTRE, KOCHI

- **Estimation on the somatic growth of stocked Indian major carps in reservoirs:** To determine the optimum density and to estimate the growth performance of the major carps, a small reservoir in Kerala, Kanhiraphuza was selected and a study was made. The growth of catla was significant followed by mrigal. The optimum stocking density for catla was estimated at 90/ha through Lorensen's density dependent growth model.
- **Biology of native fishes:** *Gonoproktoerus curmuca* and *Puntius spp* form the native fishery in Kanhiraphuza reservoir. A biological study on reproductive biology, food and feeding habits and length weight data was taken up.
- **Ecology and fisheries of Vazhani reservoir (Kerala):** Data on biotic and abiotic parameters, primary production and fisheries of this small reservoir was collected to understand the ecological status and the habitat preference of the native fishes. The landing data was noted to study the fish catch composition.

NATIONAL BUREAU OF FISH GENETIC RESOURCES REGIONAL RESEARCH UNIT IN KOCHI

- Genetic diversity among the natural populations of Indian white shrimp, *Fenneropenaeus indicus* was carried out using polymorphic microsatellite markers and four genetically distinct populations were identified. This will be useful in commercial shrimp breeding and selection programmes and management of natural stocks of Indian white shrimp.
- Eighteen polymorphic single-locus microsatellite markers were developed in pomfret, 19 in cobia and 17 golden anchovy. These polymorphic primers will be used for population genetic studies of these species.
- Species-specific signatures of 12 finfish and shellfish species enlisted in Schedule-I of the Indian Wildlife (Protection) Act, 1972 were generated to aid in their conservation and to curb the illegal trade.
- Captive breeding and milt cryopreservation technique were developed for endemic and endangered fish of the Western Ghats viz. *Puntius sarana subnasutus*, *Osteochilichthys longidorsalis* and *Puntius chalakkudiensis*.
- Checklists of macro fauna and macro flora of Gulf of Mannar Marine Biosphere Reserve (3144 species) were prepared which will help in sustainable utilization and management of resources of the region.
- Pearl spot fin (PSF) and Red-line torpedo fin (RTF) cell lines developed at the centre from caudal fin of *Etroplus suratensis* and *Puntius denisonii* respectively were characterized. The cell lines were cryopreserved in liquid nitrogen at -196°C.

- Prepared guidelines for Green Certification of Freshwater Ornamental Fish incorporating aspects such as collection from the wild, handling, transport, holding, breeding and culture facilities, conditioning for export, infrastructure and maintenance of records jointly with the Marine Products Development Authority.

New technology ready for transfer

- Sperm cryopreservation protocol for *Puntius sarana subnasutus*, *Osteochilichthys longidorsalis* and *Puntius chalakkudiensis*.
- Information on genetic stock structure and 81 polymorphic microsatellite markers in *Fenneropenaeus indicus* that will be useful in commercial shrimp breeding and selection programmes; and management of natural stocks of Indian white shrimp.
- Species-specific signatures of 12 finfish and shellfish species enlisted in Schedule-I of the Indian Wildlife (Protection) Act, 1972 aiding in their conservation and to curb the illegal trade of these species.
- Polymorphic microsatellite markers developed in cobia (*Rachycentron canadum*), silver pomfret (*Pampus argenteus*) and golden anchovy (*Coilia dussumieri*) to study genetic diversity.

CHAPTER XI

STATUS OF AGRICULTURAL EDUCATION

The Education Division of ICAR coordinates, guides and supports activities related to agricultural education and training in the country. ICAR as such does not enjoy any statutory power to regulate agricultural education, but it has the mutually shared goal and commitment for improving the agricultural education that binds ICAR, State Agricultural Universities (SAUs) and other institutions together in a close professional relationship. Financial support provided by the ICAR for strengthening and development of agricultural education helps in firming up this tie up. The Education Division jointly with SAUs and others has taken a number of steps for institutionalizing reforms for streamlining and improving agricultural education in the country. Serious efforts have been made on strengthening quality and relevance of agricultural education through accreditation, periodic course curricula revision, in-service training and necessary infrastructure development.

The Education Division of ICAR co-ordinates the operation of following schemes/activities for strengthening, development and quality assurance of agricultural education.

- 1) Development and Strengthening of SAUs, DUs, CUs
- 2) Rural Awareness Work Experience
- 3) Best Teacher Award
- 4) Emeritus Scientist Scheme
- 5) University Level Text Book writing
- 6) National Talent Scholarship
- 7) Summer/Winter School
- 8) Centre of Advanced Faculty Training
- 9) Admission of Foreign Students
- 10) National Fellows
- 11) Admission in UG and PG programmes through All India Competitive Exams.
- 12) Accreditation Board
- 13) Niche Areas of Excellence
- 14) Experiential Learning Unit
- 15) Modernization of AU Farms
- 16) ICAR International Fellowships Programme

Although investment by ICAR on improvement in agriculture education is supplementary in nature, it has unquestionably helped in removing major inconsistencies in educational norms and standards necessary to sustain uniformly high quality of agricultural education in the country. The funds released during last two years under the various activities including Development Grant, International and Girls Hostels, Educational Museum, RAWE, Niche Area of Excellence, Experiential Learning, Modernization of AU Farms and Human Resource Development scheme are as under:

Development grant

(Rs. in crores)

State	University	2009-10	2010-11
Karnataka	UAS, Raichur	3.75	3.80
	UAS, Bangalore	4.75	6.80
	UAS, Dharwad	2.80	4.10
	UHS, Bagalkot	--	4.30
	KVAFSU, Bidar	3.05	3.30
Kerala	KVASU, Pookode	--	--
	KAU, Thrissur	4.10	4.75
	KUFOS, Kochi	--	--
Tamil Nadu	TNAU, Coimbatore	3.10	3.50
	TANUVAS, Chennai	4.33	4.30

Hostels and educational museum (Number sanctioned and grant released)

State	University	No. of girls hostels	International Hostel	Educational Museum
Karnataka	UAS, Raichur	1	1	1
	UAS, Bangalore	--	--	--
	UAS, Dharwad	2	--	1
	UHS, Bagalkot	1	--	--
	KVAFSU, Bidar	2	1	1
Kerala	KVASU, Pookode	--	--	--
	KAU, Thrissur	1	--	1
	KUFOS, Kochi	--	--	--
Tamil Nadu	TNAU, Coimbatore	1	--	--

Rural Awareness Work Experience

(Rs. in lakhs)

State	University	2009-10	2010-11
Karnataka	UAS, Raichur	3.00	4.73
	UAS, Bangalore	9.00	12.78
	UAS, Dharwad	9.00	10.49
	UHS, Bagalkot	--	--
	KVAFSU, Bidar	--	--
Kerala	KVASU, Pookode	--	--
	KAU, Thrissur	--	--
	KUFOS, Kochi	--	--
Tamil Nadu	TNAU, Coimbatore	3.00	30.42
	TANUVAS, Chennai	--	--

Niche Area of Excellence

(Rs. in lakhs)

State	University	2009-10	2010-11
Karnataka	UAS, Raichur	--	--
	UAS, Bangalore	60.00	42.00
	UAS, Dharwad	45.00	58.00
	UHS, Bagalkot	--	--
	KVAFSU, Bidar	--	--
Kerala	KVASU, Pookode	--	--
	KAU, Thrissur	35.00	30.00
	KUFOS, Kochi	--	--
Tamil Nadu	TNAU, Coimbatore	50.00	60.00
	TANUVAS, Chennai	40.00	30.00

Experiential Learning / Hands-on Training

(Rs. in lakhs)

State	University	2009-10	2010-11
Karnataka	UAS, Raichur	--	--
	UAS, Bangalore	2.00	--
	UAS, Dharwad	2.00	--
	UHS, Bagalkot	--	72.20
	KVAFSU, Bidar	2.00	--
Kerala	KVASU, Pookode	--	--
	KAU, Thrissur	2.00	--
	KUFOS, Kochi	--	--
Tamil Nadu	TNAU, Coimbatore	2.00	--
	TNUVAS, Chennai	2.00	--

Modernization of Agricultural University Farms

Under the sub-scheme "Modernization of AU Farms", the Council has provided financial support for the works related to farm structures and facilities including up-gradation/renovation and procurement of farm implements/equipments to the agricultural universities as detailed below.

(Rs. in crores)

State	University	2009-10	2010-11
Karnataka	UAS, Raichur	1.45	2.15
	UAS, Bangalore	3.25	5.75
	UAS, Dharwad	1.85	2.95
	UHS, Bagalkot	--	1.77
	KVAFSU, Bidar	1.75	3.40
Kerala	KVASU, Pookode	--	--
	KAU, Thrissur	2.75	4.15
	KUFOS, Kochi	--	--
Tamil Nadu	TNAU, Coimbatore	1.50	4.15
	TANUVAS, Chennai	3.13	3.15

Human Resource Development

Education Division of ICAR conducts a common entrance test at All India level to fill up the 15% seats at UG level and 25% seats at PG level available in all State Agricultural Universities.

Number of students selected for JRF and SRF during 2009-10 and 2010-11

Name of the university	2009-10		2010-11	
	JRFs	SRFs	JRFs	SRFs
UAS, Raichur	6	--	2	--
UAS, Bangalore	26	2	23	7
UAS, Dharwad	9	6	10	4
UHS, Bagalkot	--	--	3	1
KVAFSU, Bidar	2	--	--	--
KVASU, Pookode	--	--	--	--
KAU, Thrissur	2	2	2	5
KUFOS, Kochi	--	--	--	--
TNAU, Coimbatore	15	3	15	17
TANUVAS, Chennai	9	2	4	1
Total	69	15	59	35

TAMIL NADU AGRICULTURAL UNIVERSITY

Under graduate programme:

The number of students particularly girls pursuing agriculture and related sciences offered by TNAU is increasing. In the academic year 2010-2011, of the 754 total candidates admitted, 503 were girls (66.72%).

Dual Degree Programs:

TNAU in partnership with Nova Scotia Agricultural College (NSAC), Canada is offering a unique undergraduate dual degree program that integrates NSAC's B. Tech. (Environmental Horticulture) and TNAU's Bachelor of Science (B. Sc. (Agri) / B. Sc. (Hort.) / B. Tech. (Horticulture)). The selected students study B. Tech. (Environmental Horticulture) for three semesters in NSAC, Canada. They are awarded two degrees viz., B. Sc. (Agri.), B. Sc. (Hort.), B. Tech (Horticulture) of TNAU and B. Tech. (Environmental Horticulture) of NSAC. In 2010-2011 academic year nine candidates have been selected and are pursuing studies at NSAC.

Syllabus Revision:

Steps have been initiated to revise the existing 2007 syllabus as per the guidelines of ICAR IV Deans' Committee meeting in which the total course credit will be increased from 136 to 160. The new syllabus will be introduced from 2011-2012 academic year.

E-learning:

Information and Communication Technology based education is being followed in TNAU and the mid semester examination is conducted in online mode. Online examination is one of

the unique features of TNAU educational system, which is implemented since 2007-08. In the 2010-2011 academic year, a total of 778 students wrote online examination. All the students' hostels were provided *wifi* connectivity to enhance the e-learning.

Post graduate

New PG programs:

Two new PG programs viz., M. Tech. (Ag.) in Agricultural Technology, M. Tech. (Ag. Engg.) in Environmental Engineering were introduced during this academic year.

Revision of PG rules and regulations and PG curricula and syllabi:

PG degree program, semester system rules and regulations were revised as per the stipulations given by National Core Group (NCG) constituted by ICAR in order to evolve agricultural education in tune with the fast changing National and International scenario. The curricula and syllabi of PG programmes in TNAU were also revised to maintain uniformly throughout the country with minor variation of 20%. This will facilitate the free Inter University movement of the student without any hurdle.

Overseas Training programmes

Three M. Sc. students (two in Horticulture and one Food & Agri. Process Engineering) and one Ph. D. student in Agricultural Microbiology have done / are doing their research work at NParks Board Singapore, Chiba University, Japan, McGill University, Canada and Justus Leibig University, Germany. A total of 34 students of International Agriculture and Rural Development (IARD 602) course and 10 faculty members from Cornell University, USA have visited TNAU during January 2010. This included 13 TNAU students of MPS Dual degree programme jointly offered by TNAU and Cornell University, USA.

MoUs

In order to bolster research on Farm Mechanization Process, a special meeting was held with M/s. Mahindra & Mahindra Ltd, Mumbai on 13.9.2010. Five PG students were selected to undertake research and innovative farming technology in selected crops and areas by using Mahindra Samridhi Grant

UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

The University of Agricultural Sciences, Bangalore has jurisdiction over 17 districts in the state of Karnataka covering nearly 50 percent of geographical area of the state. The University with its six teaching campuses, one each at Bangalore, Chintamani, Hassan, Mandya, Ponnampet and Shimoga has taken several steps to improve course curriculum and practical training in the seven undergraduate degree programmes, 20 Master's degree programmes and 13 Doctoral programmes. Postgraduate programmes are also offered at Shimoga and Ponnampet campuses. The University has started two year diploma in agriculture from the academic year 2011-2012 at Mandya and Kattalagere campus and offers three Diploma Courses in Baking Technology, Sericulture and Agricultural Extension Services for Input dealers (DAESI)

Students Admission

- During the year 2010-2011, 696 candidates were admitted to Bachelor Degree Program, 245 candidates to Masters Degree Programs and 79 candidates to Doctoral degree program, including four foreign nationals to UG and seven foreign nationals to PG programs. 64 candidates were also admitted to various Diploma courses, which include 27 for Agricultural Extension Services for Input Dealers (DAESI), seven for Baking technology and 30 for Horticulture Nursery Management.

- During the year 2011-12, 815 students were admitted to UG courses, 223 students to PG programs, 93 students to Doctoral Programs and 75 students to one year Diploma courses. University has started two year Diploma in agriculture from the academic year 2011-12 at Mandya and Kathalagere campus. A total of 103 students have been admitted for this program. Started distance education program in Integrated Farming Systems and Post Harvest & value addition for the benefit of rural youth. During the year it is targeted to enroll 1000 students for the program.

Convocations

- **The 44th Convocation of UAS, Bangalore was held on 25th September 2010.** During 44th Convocation, 662 students are conferred with various degrees, of which 366 Bachelor's Degrees, 252 Masters Degrees and 44 Doctoral Degrees.
- **The 45th Convocation of UAS, Bangalore was held on 6th August 2011.** During the 45th Convocation a total of 656 candidates were awarded with various degrees which include 338 Bachelors, 272 with Masters and 46 with Doctoral degrees.

UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

- During 2010-11, one year diploma courses have been started for X standard pass students in agriculture & allied fields i.e., Seed Production, Organic Farming, Fashion & Apparel Designing, Plant Protection, Floral Decoration and Consumer Utility Products.
- During 2011-12 two year diploma course in Agriculture was started at Dharwad, Bijapur, Sirsi, Bagalkot, Hukkeri (Belgaum Dist.) and Akki Alur (Haveri Dist.) and Six months Certificate Courses were introduced in subject areas like Seed Production, Organic Farming, Dairy Farming, Poultry Farming, Nursery Management, Hi-Tech Agriculture, Farm Women Enterprises and Sugarcane and Sugar Beet Production Technology.
- During the academic year 2011-12 a new College of Agriculture has been started at Hanumanamatti, Tq: Ranebennur, Dt. Haveri.

UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT

The University of Horticultural Sciences, Bagalkot was established during 2008 as the first Horticultural University in the state and third in the country.

- Four colleges with staff and students were transferred from University of Agricultural Sciences, Dharwad and Bengaluru.
- UHS, Bagalkot started giving admission for UG/PG degree programmes from the academic year 2009-10 and 220 and 36 students were admitted for B.Sc. and M.Sc. degree programmes respectively during the year. College of Horticulture, Kolar was started during the year 2009-10.
- During the academic year 2010-11, four more colleges were established at Sirsi, Hiriya, Mysore and Munirabad (Koppal) and one PG Centre at Bengaluru. The intake capacity for B.Sc., M.Sc., and Ph.D was 362, 83 and 16 respectively during the year.
- During the academic year 2011-12 the intake of students was 445, 85 and 19 for B.Sc., M.Sc., and Ph.D respectively.
- At present following disciplines are offered for M.Sc. degree programme :
 - Floriculture & Landscape Architecture
 - Fruit Science
 - Horticultural Entomology

- Plantation, Spices, Medicinal & Aromatic Crops
- Crop Improvement & Bio-Technology
- Horticultural Pathology
- Post Harvest Technology
- Vegetable Science

Convocation: The first Convocation of this University was held on 27.12.2011, 95 B.Sc. (Hort.) and 11 M. Sc. (Hort.) students were conferred degrees during the Convocation.

Student strength at UHS, Bagalkot for the academic year 2011-12

Sl.	Degree	Boys	Girls	Total Strength
1.	B.Sc. (Horticulture)	678	506	1184
2.	M.Sc. (Horticulture)	107	61	168
3.	Ph.D.	25	07	32
	Total	810	574	1384
	Percentage	58.53%	41.47%	100%

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

The new courses started during the period 2010-11 are M.Sc. Integrated course on Climate Change Adaptation, B. Tech. Food Engineering, P.G. Diploma in Solid Waste Management, Diploma in Agricultural Science, Certificate courses and Ph. D course at KCAET, Tavanur. International Students Hostel was constructed with ICAR aid. The Kerala Agricultural University won Performance Award of ICAR for student performance in National level examinations for six consecutive years (2006 to 2011).

The Faculty of Fisheries and Veterinary & Animal Sciences were disaffiliated from KAU and Kerala University of Fisheries and Ocean Studies (KUFOS) and Kerala Veterinary and Animal Sciences University (KVASU) were formed w.e.f. 01.04.2011. The No. of seats of the courses conducted by KAU are as follows from 2010 onwards.

Faculty of Agriculture	Intake capacity from 2010
B.Sc. (Ag)	209
B.Sc. (Forestry)	30
B.Sc. (C&B)	40
M.Sc. (Ag)	120
M.Sc. (C&B)	6
M.Sc. (Forestry)	13
Ph. D (Forestry)	5
Ph. D (Agri)	48
M. Sc. Integrated course in Biotechnology	20
M. Sc. in Climate Change Adaptation	20
MBA	40

Faculty of Agriculture	Intake capacity from 2010
PG Diploma in Solid Waste Management	10
Diploma in Agrl. Science	50
Faculty of Agrl. Engineering	
B. Tech. (Ag. Engg.)	46
M. Tech. (Ag. Engg.)	15
Ph. D.	3
B. Tech. (Food Engineering)	30

RAWE Allowance of B. Sc. (Ag) students enhanced to Rs.8000/-p.m. per student, sanctioned by the Govt. of Kerala from the Plan Fund of Dept. of Agriculture taking into consideration the participation of students in the Panchayath level planning for agricultural development and to handle the present and emerging demands of agricultural sector.

The Govt. issued sanction to start P.G. course in Seed Technology at College of Horticulture, Vellanikkara from 2012-13.

PG / Ph. D. Fellowships and contingencies were enhanced by the Govt. of Kerala. An amount of Rs.190.40 lakhs was sanctioned for this purpose from the Plan Fund 2011-12.

CHAPTER XII

PROGRESS IN TRANSFER OF TECHNOLOGIES

ZONAL PROJECT DIRECTORATE

Technology Assessment, Refinement and Transfer

There are 78 KVKs in the Region VIII. During the period under report, three new KVKs viz., Additional KVKs at Belgaum and Gulbarga in Karnataka and new KVK at Yanam in Puducherry were established. The state wise status and details of KVKs established during XI Plan are given in Tables 10 and 11 respectively.

Table 10. State-wise status of Krishi Vigyan Kendras

State	No. of KVKs approved	Details of KVKs established					Total
		SAU	NGO	ICAR	DU	State Dept. of Agri.	
Karnataka	31	23	05	02	-	-	30
Kerala	14	07	03	04	-	-	14
Tamil Nadu	30	17	11	-	02	-	30
Puducherry	04	-	-	-	-	03	03
Lakshadweep	01	-	-	-	-	01	01
Total	80	47	19	06	02	04	78

Table: 11 Details of establishment of new KVKs during XI Plan

Name of the State	Details of KVK	No. of KVKs approved	No. of KVKs estd.	Site selection completed	No proposal received
Karnataka	New KVK	2	1	1	-
	Additional KVK	3	3	-	-
Puducherry	New KVK	2	1	-	1
Total		7	5	1	1

Activities of KVKs

KVKs are Knowledge and Resource Centres in agriculture and its allied sectors, which aim for developing and dissemination of location specific technological modules through Technology Assessment, Refinement and Demonstration.

Thrust areas

KVKs plan and implement their activities based on the location specific problems in the major crops / enterprises of the operational areas. Normally, three villages are covered in each district by working intensively using appropriate Participatory Rural Appraisal Techniques (PRA) and the problems are identified and prioritized. Then based on technologies available from the National Agricultural Research System (NARS), specific thrust areas are identified for tackling the

problems through various technological interventions and extension programmes. The major thrust areas for KVKs in different States are furnished below:

Karnataka

- Sustainable crop production through integrated nutrient management and organic farming strategies
- Integrated pest and disease management
- Introduction and popularization of improved varieties / hybrids of crops through technical and material back up.
- Development and promotion of crop diversification and alternate land use system
- Rain Water Harvesting, soil and water conservation.
- Integrated Farming Systems.
- Promotion of dry land farming on watershed basis with special reference to dry land horticulture
- Income generation to rural women focusing on Post Harvest Technology and Value Addition on Supply Chain Mechanism
- Production and management of livestock, poultry and fisheries

Tamil Nadu

- Promotion of High Yielding Varieties / Hybrids / breeds for achieving higher productivity in various crops, livestock and poultry
- Sustainable and profitable paddy cultivation focusing on technologies like Systems of Rice Intensification
- Soil and water management
- Integrated Pest and Disease Management
- Integrated Farm Development
- Promotion of dry land horticulture and agro-forestry
- Integrated Crop Management for higher productivity
- Post Harvest Technology and Value Addition for realizing better profitability to rural women
- Disease management in livestock
- Production and management of livestock, poultry and fisheries

Kerala

- Promotion of sustainable and profitable perennial crop based farming systems
- Introduction and popularization of improved varieties / hybrids of crops, livestock and poultry for achieving higher productivity
- Soil, water conservation technologies for drought proofing and sustainable rainfed farming
- Small scale mechanization for saving time and reducing cost and drudgery
- Increasing income from fishery enterprises through production, processing and marketing
- Scientific management of dairy and small livestock

Puducherry

- Sustainable and profitable paddy cultivation
- Integrated Crop Management in cereals, oilseeds and vegetables

- Post Harvest Technology and Value Addition for realizing better profitability to rural women
- Production and management of livestock, poultry and fisheries

Lakshadweep

- Promotion of sustainable and profitable perennial crop based farming systems
- Post Harvest Technology and Value Addition for realizing better profitability to rural women

Technology Assessment and Refinement

Research conducted under controlled conditions often need fine tuning before their adoption in farmer's fields. With the objective of developing location specific technology modules, the primary mandate of KVKs is made as technology assessment and refinement. The entire process is done on participatory mode involving the clients. The process of Technology Assessment and Refinement (TAR) is done through On Farm Trial (OFT). Once a particular technology option is found to be technically feasible, socially acceptable, economically viable and environmentally safe in a particular location specific environment, then the same can be popularized among the farming community through Front Line Demonstrations. If not, the best performing technology option may be modified a little to suit the local conditions through technology refinement and then popularized through FLDs. Details of Technology Assessment and Refinement conducted for during the period under report is presented in Table 12.

Technology Assessment

During the reporting period, under crops, 751 technologies were assessed through 5045 On Farm Trials. The thematic areas include Varietal Evaluation, Integrated Crop Management, Integrated Nutrient Management, Integrated Disease Management, Integrated Pest Management, Integrated Farming System, Resource Conservation Technology, Weed Management, Farm Mechanization, Seed / Plant Production, storage techniques and value addition.

In case of livestock, poultry and fisheries, 130 technologies were assessed through 3392 On Farm Trials. The thematic areas include Disease Management, Evaluation of Breeds, Feed and Fodder Production, Nutrition Management and Production and Management.

With respect to other enterprises like mushroom production, sericulture, artimia culture, vermi-compost production etc., 26 technologies were assessed through 309 On Farm Trials. This include small scale enterprises, mushroom production, sericulture, artimia culture, market led extension and vermicomposting.

Overall 905 technologies were assessed through 8742 On Farm Trials. The State Wise data indicated that KVKs in Karnataka have assessed 335 technologies through 2936 On Farm Trials. The same in the case of Tamil Nadu was 379 technologies and 4123 On Farm Trials, Kerala 167 technologies through 1496 On Farm Trials, Puducherry 10 technologies through 88 On Farm Trials and Lakshadweep 14 technologies and 99 On Farm Trials.

Technology Refinement

During the reporting period, 62 technologies were refined through 467 On Farm Trials. This includes Farm machineries, Integrated Crop Management, Integrated Nutrient Management, Integrated Pest Management, Integrated Disease management, Resource Conservation Technology, Storage Technique, Value Addition, Seed / Plant Production and Weed Management.

In case of other enterprises, 3 technologies were refined through 17 On Farm Trials in four locations. This includes small-scale enterprises and mushroom production.

Table 12. Statewise details of technology assessment

State	Crops		Livestock, poultry and fisheries		Other enterprises		Total	
	No. of Technologies	No. of trials	No. of Technologies	No. of trials	No. of Technologies	No. of trials	No. of Technologies	No. of trials
Karnataka	298	2171	29	712	8	53	335	2936
Tamil Nadu	311	1708	62	2278	6	137	379	4123
Kerala	124	1041	31	336	12	119	167	1496
Puducherry	8	68	2	20	0	0	10	88
Lakshadweep	10	57	4	42	0	0	14	99
Total	751	5045	128	3388	26	309	905	8742

Overall 65 technologies were refined through 484 On Farm Trials. State Wise information indicated that KVKs in Karnataka have refined 25 technologies through 233 On Farm Trials; KVKs in Tamil Nadu have refined 22 technologies through 140 On Farm trials. The same in case of KVKs in Kerala was 18 technologies through 111 On Farm Trials.

Table 13. State Wise details of Technology Refinement

States	Crops		Other Enterprises		Total	
	No. of Technologies	No. of trials	No. of Technologies	No. of trials	No. of Technologies	No. of trials
Karnataka	24	229	01	04	25	233
Tamil Nadu	22	140	-	-	22	140
Kerala	16	98	02	13	18	111
Total	62	467	03	17	65	484

Salient findings

- PMR (R) 4 (Anna 4) paddy variety was found suitable for Cuddalore, Thiruvallur and Villuppuram districts of Tamil Nadu and the average increase in yield was 12.68%
- Pulse wonder, a new technology released by TNAU, Coimbatore for increasing the productivity of pulses was found to be highly suitable for Cuddalore, Villuppuram, Dharmapuri, Ramanathapuram, Kancheepuram, Thiruvallur, and Vellore districts of Tamil Nadu and the average realized yield in case of blackgram was 7.60 q/ha
- Assessment of various groundnut varieties in Northern Karnataka indicated that GPBD -4 and ICGV-91114 performed better both in Belgaum and Gadag districts
- Assessment of nutrient management in banana in Alleppey and Kottayam districts of Kerala revealed that Banana Special from IIHR Bangalore and Banana Sakthi from NRCB Trichy along with the recommended dose of fertilizers were equally effective in increasing the yield

- Spraying of Mancozeb @ 2.5 g/l along with cleaning of infected bunches reduced the incidence of inflorescence die back disease in arecanut in Chickmagalur, Dakshina Kannada and Udupi districts of Karnataka
- Papaya mealy bug (*Paracoccus marginatus*) was effectively controlled by release of Eulophid parasitoid (*Acerophagus papaya*) @ 50 parasitoids/ha.
- Multi-row power weeder developed by TNAU Coimbatore was found suitable for paddy cultivation through Systems of Rice Intensification (SRI) in Ariyalur, Erode, Nagappatinam, Salem, Thiruvarur and Thanjavur districts of Tamil Nadu
- Area Specific Mineral Mixture for dairy cows increased the milk yield by 56.65 % in Cuddalore, Dharmapuri, Dindigul, Kancheepuram, Pudukottai, Shivagandai and Thiruvarur districts of Tamil Nadu
- Estrus synchronization with Controlled Internal Drug Release Device (CIDRD) and Estrus synchronization with Ovo Sync Technology were found to be effective improving the conception rate of dairy cows in Coimbatore, Erode and Kancheepuram districts of Tamil Nadu
- Shunted carp can be cultivated profitably with stocking size of 1.5" and stocking density of 1500 in a tank of 1200 sq. ft.

Frontline Demonstrations

Frontline Demonstrations (FLDs) were conducted to demonstrate the production potential of the newly released production technologies in a given farming system. Training programmes and field days were organized for extension workers and farmers in the demonstration plots for dissemination of technologies.

During the period under report in crops category, 12788 demonstrations were conducted in an area of 6158.73 ha. The major technologies demonstrated include Integrated Crop Management, Popularization of High Yielding Varieties/Hybrids, Integrated Pest Management, Integrated Disease Management, Integrated Nutrient Management, Post Harvest Technology and Value Addition, Soil and Water Conservation etc.

State-wise data indicated that with respect to crops, KVKs in Karnataka have conducted 5475 demonstrations in an area of 3614.28 ha. The respective figures for Tamil Nadu were 6108 in 2231.64 ha, Kerala 995 in 221.41 ha, Puducherry 176 in 68.9 ha and Lakshadweep 34 in 22.5 ha.

Table 14. State-wise details of Frontline Demonstrations in crops

States	No. of demonstrations	Area (ha)
Karnataka	5475	3614.28
Tamil Nadu	6108	2231.64
Kerala	995	221.41
Puducherry	176	68.9
Lakshadweep	34	22.5
Total	12788	6158.73

In case of livestock, fisheries and other enterprises 3847 demonstrations were conducted in 10474 units. The major technologies which were demonstrated include high yielding breeds, disease management, nutrition management, value addition, mushroom production, vermicompost production, small scale enterprises etc.

KVKs in Karnataka have conducted 1278 demonstrations through 2549 units. The same in the case of Tamil Nadu was 1619 and 6388, in Kerala 919 and 1469, in Puducherry it was 31 demonstrations conducted through 68 units.

Table 15. State-wise details of Frontline Demonstrations in enterprises

States	Livestock and poultry		Fisheries		Other Enterprises		Total	
	No. of FLDs	No. of Units	No. of FLDs	No. of Units	No. of FLDs	No. of Units	No. of FLDs	No. of Units
Karnataka	1043	2317	56	53	179	179	1278	2549
Tamil Nadu	1442	6229	122	104	55	55	1619	6388
Kerala	894	1444	5	5	20	20	919	1469
Puducherry	14	50	12	13	5	5	31	68
Total	3393	10040	195	175	259	259	3847	10474

In case of farm implements, 1410 demonstrations were conducted. KVKs have Karnataka have undertaken 301 demonstrations and the same in case of Tamil Nadu it was 1010, Kerala 93 and in Lakshadweep it was 6 demonstrations.

Salient findings

- In the demonstrations on high yielding varieties of groundnut viz., TMV-13, GPBD-4, TMV-7, VRI-6, JSP-39, R-2001-12, the increase in yield over check ranged from 7.33 % in Puducherry to 29.75 % in Tamil Nadu.
- High yielding varieties of sesame namely VRI (SV)-1, VRI (SV)-2, SVPR-1 and TMV-4 were demonstrated through Integrated Crop Management, in which the percentage increase over check ranged from 32.48 in Karnataka to 33.3 in Tamil Nadu.
- In demonstrations of high yielding varieties of in blackgram viz., VBN-4, ADT-3, VBN-5, VBN-3, DU-1 LBG-625, JS-11, GBS-964, the percentage of increase in yield ranged from 22.61 in Tamil Nadu to 36.32 in Karnataka.
- In demonstrations on varietal evaluation of greengram with VBN-3, VBN 2, VRM-1, Co-7, Co -7 and S-4, the percentage of increase in yield over check ranged from 13.24 in Tamil Nadu to 26.0 in Karnataka.
- In case of redgram, high yielding varieties viz., BRG-2, TS-3R, VBN-2, Co7 and VBN 3 gave an increase in yield of 31.05% over the check.
- Demonstrations on high yielding varieties of paddy viz., Co (R) 49, CR 1009, RSS-17, IET-13901, KMP-101, Hemavathy, Sharavathy, Tanu, Champaka, KKL(R)- 1 and Manupriya resulted in increase in yield ranging from 10.80% in Kerala to 35.50% in Tamil Nadu.
- Integrated Crop Management in paddy with ASD 16, BPT 5204, ADT-39, ADT-43, ADT-48, Revati, MO-9, Uma, Njavara, Vaishak, TRY-1, MAS-946-1 and PMK-4 gave an increase in yield of 16.86%.
- Demonstrations on high yielding fodder grass viz., Co-4, COFC 8, Co (Cu) 9 and Co-3 realized an increase in yield ranging from 33.69 % in Tamil Nadu to 35.67 in Karnataka.
- Demonstrations conducted on banana realized an increase in yield ranging from 12.20 in ratoon management to 47.84 in pest management.

- Integrated Crop Management in arecanut with High Yielding Varieties viz., Mangala and Sumangala gave an increase in yield of 36.21 %.
- Demonstrations on ginger variety Varadha gave an increase in yield of 40.78 %.
- Demonstrations were conducted using farm Implements such as rotavator, helical blade puddler, planting, transplanting equipments such as drum seeder, paddy transplanter, weeding equipment's including cycle weeder, power weeder, rotary power weeder, saral-kurupi, sugarcane de-thrasher, harvesting equipments including cassava harvesting tool, coconut tree climber, post-harvest equipments including cassava chipping machine, chaff cutter, groundnut stripper, groundnut decorticator, sugarcane sett cutter, improved turmeric boiler and power sprayer.

Training Programmes

During the reporting period, 17165 training programmes were organized with the participation of 444065 farmers including rural youth and in-service extension personnel. Besides, KVKs also conducted 3456 sponsored training programmes in which 124749 have participated. In addition 882 vocational training programmes were conducted for 17496 youths on various aspects. The major thematic areas of these training programmes include crop production management of horticultural crops, soil and fertility management, livestock production and management, Home Science / Women Empowerment, Farm Mechanization, Plant Protection, Fisheries Production and Management, Production of inputs at site, Capacity Building and Group Dynamics, Agro-forestry, Rejuvenation of old orchards, Protected Cultivation Technology, Group Dynamics and Farmer's Organization, Capacity Building for ICT Application, Household Food Security, Animal Nutrition Management, Animal Disease Management etc.

Table 16. Need based training programmes conducted to farmers, rural youth and extension personnel (number of courses and participants)

State	Farmers		Rural youth		Extension Personnel		Total	
	Courses	Parti-cipants	Courses	Parti-cipants	Courses	Parti-cipants	Courses	Parti-cipants
Karnataka	5712	125630	330	7068	429	6592	6471	139290
Tamil Nadu	8621	178809	1484	24835	941	21678	11046	225322
Kerala	2062	39073	526	9321	203	3446	2791	51840
Puducherry	252	5269	32	706	51	1312	335	7288
Lakshadweep	518	16800	79	2747	46	778	643	20325
Total	17165	365581	2451	44677	1670	33806	21286	444065

Extension Programmes

KVKs organized 195947 extension programmes covering 156.89 lakh farmers and others to create awareness about improved agricultural technologies. The activities include advisory services, agriculture camps, animal health camp, celebration of important days, diagnostic visits, exhibition, exposure visits, extension literature, ex-trainees sammelan, farm science club conveners meet, farmers seminar, farmers visit to KVK, field day, field visits, film show, group meetings, kisan gosthies, kisan mela, lectures, mahila mandal conveners meetings, method demonstrations, scientists visit to farmers field, self-help group conveners meetings, soil test campaigns, workshops, newspaper coverage, popular articles, radio talks and TV coverage.

Table 17. Sponsored and vocational training programmes conducted

State	Sponsored Training Programmes		Vocational Training Programmes	
	No. of courses	No. of participants	No. of courses	No. of participants
Karnataka	1054	42185	165	4572
Tamil Nadu	1631	52568	467	8431
Kerala	672	24676	185	3255
Puducherry	81	4258	23	60
Lakshadweep	18	1062	42	1178
Total	3456	124749	882	17496

Table 18. State-wise details of Extension Programmes

State	No. of programmes	No. of participants (in lakhs)		
		Farmers	Extension personnel	Total
Karnataka	81699	142.80	3.01	145.82
Tamil Nadu	65788	4.92	0.64	5.56
Kerala	46517	4.60	0.10	4.70
Puducherry	1739	0.59	0.04	0.63
Lakshadweep	204	0.17	0.02	0.18
Total	195947	153.08	3.81	156.89

Kisan Mobile Advisory Service

In order disseminate vital information immediately to the farming community, under the guidance of ICAR, KVKs are implementing Kisan Mobile Advisory Services, through which important messages like weather information, outbreak of pests and diseases, availability of technological inputs are being sent to farmers mobile phone through Short Message Service (SMS). During the reporting period 9772 messages were sent in which 6347 from KVKs of Karnataka, 1967 from Tamil Nadu, 1279 from Kerala, 104 from Puducherry and 25 from Lakshadweep

Technology Week

During the reporting period, Technology Week was observed by the KVKs, in which 271422 farmers have participated. During the Technology Week celebration, need based technologies on crop improvement, crop production, crop protection, post-harvest technology and value addition, horticulture, livestock, farm machineries, fisheries and other allied sectors were demonstrated and explained to the farmers, members of SHGs, extension officials and seminars were conducted on thematic areas of local importance with focus on agro-based enterprises and income generation activates.

Production and supply of quality technological products

KVKs have produced and provided 12563.73 q of seed material including cereals, oilseeds pulses, vegetables and others valued at Rs. 209.23 lakhs and provided to 126661 farmers. In addition, 444.22 q of hybrid seeds were produced and provided to 722 farmers. Regarding

planting materials, KVKs supported 2.15 lakh farmers by providing 99.24 lakh numbers of planting materials of fruits, vegetables, spices, forest species, ornamental plants, plantation crops and others. KVKs have also produced and provided 242414 livestock and fisheries strains including cattle, sheep and goat, poultry, and fisheries to 10764 farmers thereby earning Rs. 60.50 lakhs. By way of production of quality bio control agents and bio fertilizers KVKs have also earned an income of Rs. 77.79 lakhs, benefitting 103735 farmers.

Table 19. Details of production and supply of technological products

Technology Product	Quantity	Value(Rs. in lakhs)	No. of farmers
Seeds -Varieties (q)	12563.73	209.23	126661
Seeds -Hybrids (q)	444.22	5.26	722
Planting materials - Varieties (No.)	7813805	208.41	198675
Planting materials – Hybrids (No.)	2110280	14.08	16396
Livestock and fisheries (No.)	242414	60.50	10764
Bio products (q)	10291.11	77.79	103735
Total		575.27	456953

Analysis of Soil, Water and Plant Materials

A total of 58568 samples of soil, water, and plant samples were analyzed, generating a revenue of Rs.39.28 lakhs benefiting 46823 farmers from 9372 villages during the reporting period by the KVKs of Karnataka, Tamil Nadu, Kerala, Puducherry and Lakshadweep.

Table 20. State-wise details on analysis of soil, water and plant samples

State	Soil, water and plant analysis			Amount realized (Rs.)
	No. of samples	No. of farmers	No. of villages	
Karnataka	28902	25328	5989	2255420
Tamil Nadu	19755	12882	2928	555214
Kerala	9391	8447	336	1087325
Puducherry	502	156	109	30440
Lakshadweep	18	10	10	101
Total	58568	46823	9372	3928500

Rain Water Harvesting unit with Micro irrigation System

In Region VIII, out of 78 KVKs, rainwater harvesting unit with micro irrigation system was established in 15. These 15 KVKs have conducted 222 training programmes, 201 demonstrations utilizing this facility and produced 1.77 lakh planting materials. Apart from this, 35275 farmers and 801 officials visited these units and get acquainted with the system.

Innovative Technology Delivery Mechanism

KVKs of Zone VIII have adopted Innovative Technology Delivery Mechanisms for addressing current issues and problems of agriculture and its allied activities.

Farm Mechanization – best practice for women empowerment in Malappuram district of Kerala

Technical empowering of farm women in farm mechanization by KVK Malappuram in Kerala has helped to revive paddy cultivation which was otherwise exhibiting a declining growth. KVK took up a project collaborating with State Planning Board to popularize mechanization of rice in Malappuram district. The project included Frontline Demonstrations in 10 ha on mechanical rice transplanting using Yanji Sakthi rice transplanter and mechanical paddy harvesting using KAMCO reaper. Aimed at equipping an ever ready work force to do the job in long run, vocational trainings were organized in mat nursery preparation, transplanting and harvesting of paddy. Six trainings and demonstrations of Yanji Sakthi rice transplanter were conducted in an area of 10 ha in the selected Panchayats involving women trainees. On gaining experience in the field under the supervision of KVK scientists, these women trainees decided to organize into a SHG. Thus with the support and supervision of KVK, 11 women formed the group named 'Krishi Sahayi'. These demonstrations motivated many farmers, who had abandoned paddy cultivation due to labour scarcity, to take it up in the next season, provided they get the work force with the machinery. The change in income earning pattern of farm women indicated that after popularization of farm mechanization, income from group activity has increased to 60% as compared.

Impact of branding in women entrepreneurship at Puducherry

KVK Puducherry has imparted training to 106 KVK women Self Help Groups and other Self Help Groups of Government and Non-Government Organizations in Pondicherry region for the empowerment of women through value addition, entrepreneurship and leadership development. The womenfolk thus trained are engaged in the production and marketing of pickle, jam, fruit squashes, papad, instant masala powder, phenyl, cleaning powder, detergent powder etc. either individually or in collectively. However, it is very difficult to sustain and survive without proper marketing strategies like proper labeling, branding, quality assurance and advertisements etc.

KVK Puducherry has taken initiative and developed a brand by name "ARUMAI" for the products produced by KVK as well as by the entrepreneurs under the guidance of KVK. This brand is used by the trainees of the KVK with the quality assurance. KVK has coined the name "ARUMAI" which means excellence for quality assurance and developed effective marketing linkages through Pondicherry Agro Services Industries Corporation, Pondicherry Agro Products Food and Civil Supplies Corporation Ltd., Uzhavar shandy, Kadhi and Village Industries Board, public exhibition etc. "ARUMAI" brand was released by Honorable Chief Minister, Puducherry during technology week celebration conducted during January 2010 and also widely popularized. The production of value added products has increased after the introduction of "Arumai" brand. The KVK trainees disseminated knowledge to 1527 members of other Self Help Groups. With the guidance and timely advisory services of KVK, brand building and with the efforts of master trainers of Self Help Groups, it was possible for them to start 55 more self-employment units

Technology led agri-preneurship and experiences of KVK Kannur in Kerala

Ten members in a Self Help Group called 'Pulari' were trained by KVK Kannur in the refined process of virgin coconut oil production. This SHG started commercial production using infrastructural facilities of KVK at first instance. The product was branded as 'KVK's Virgin Coconut Oil' and labeled attractively. The product was sold through 'KVK Mall' which is a state of art facility of KVK for marketing of value added products. Concerted efforts are done to give wide publicity through mass media, printed media and exhibitions about uses and benefits of virgin coconut oil production. The response from public was overwhelming and lot of enquiries even from distant places came.

A study on consumer acceptance conducted on the product revealed continuous usage of the product by the consumers due to the benefits and quality of product. The Pulari SHG produced and sold 400 litres of virgin coconut oil and another SHG at Pappinisseri was trained in

virgin coconut oil production and they instantly started commercial production and marketing. Their marketing channel even crossed boundaries of Kerala state to Bangalore in Karnataka. The SHG produced and marketed 500 litres of virgin coconut oil. A Front Line Demonstration was conducted by the KVK for production and marketing of virgin coconut oil under common brand name through Federation of NABARD – KVK Farmer's Clubs. Five Clubs were selected and given training in virgin coconut oil production and soon after training they started production of virgin coconut oil. The net return through value addition was Rs.62500/ha of coconut cultivation and the value addition factor was 2.23.

Innovative approach in sericulture in Mysore district of Karnataka

Sericulture is the traditional and cultural entity of Karnataka in general and Mysore district in particular. During 2009 sericulture was taken up in 682 villages with an average cocoon yield of 59 kg/100DFLs. KVK Mysore identified the villages and farmers for establishment of Chawki Rearing Centres (CRCs) and formatted Self Help Groups involving SC/ST and other weaker sections in the society. KVK also imparted soft skills to members on management and maintenance of SHGs and they were equipped to initiate activities in CRCs and maintain by themselves. Regular follow up and technical guidance were also given for the smooth functioning of CRCs. As a result two CRCs have earned an income of Rs. 98760 with a profit of Rs.36600/-. Each farmer from the group could earn Rs. 1500-2000/month and more number of sericulture farmers in the surrounding villages were also benefitted by getting quality chawki worms and other critical inputs.

Human Resource Development

During the reporting period ten training programmes were conducted by the Zonal Project Directorate and trained 175 KVK staff. Out of which 25 are Programme Coordinators were trained on agri-business management and 129 newly joined Subject Matter specialists in KVKs were trained on Technology Assessment, Refinement and Demonstration and building alliances through team spirit. Three programmes on production of banana special, vegetable special and one on production and neem and pongamia soap formulations were organized at IIHR Bangalore during May 2010. KVK staff have also attended 248 training courses conducted by National Agricultural Research System.

Technological Backstopping by Directorates of Extension

A total of 36 training programmes were conducted by five SAUs in the Zone VIII, in which 659 KVK staff have participated. The topics include i) Sensitization programme on agri tech portal & ICT tool for north eastern zone, ii) Strategies to mitigate papaya mealy bug, iii) Team Work and Building Alliances for Development, iv) Seed production, v) Participatory extension tools and techniques, vi) Climate change and its impact in agriculture, vii) Recent advances in soil, plant and water analysis, viii) crop planning strategies, ix) Site specific nutrient management, x) Care and maintenance of kiosks, xi) Participatory training management, xii) Dry land agriculture, xiii) Watershed management, xiv) Information Technology in Agricultural Extension, xv) Extension strategies for promotion of organic farming, xvi) Management of post-harvest technology and value addition, xvii) Integrated Pest and Disease Management, xviii) Value addition of livestock and fish products for income generation, and xix) ICT in extension outreach for livestock development.

In addition, the Directorates of Extension have conducted 38 workshops, meetings and seminars to 687 KVK staff on themes such as i) Possibilities and Challenges in technology transfer from Lab to Farmer's field – A way forward, ii) Agri-Food Technology and iii) Quality protein maize production etc.

Special Programmes

Pulse Crop Demonstrations

Technology demonstrations were carried out for harnessing pulse production in Zone VIII in two seasons' viz., kharif and rabi during 2010-11. During Kharif season, a total of 455 demonstrations including blackgram (46), greengram (132), and pigeon pea (277) covering an area of 215.8 ha were implemented in the pulse growing districts of Karnataka and Tamil Nadu under technology demonstration of harnessing pulse production in the country.

During rabi season, a total of 382 demonstrations including blackgram (113), greengram (64) and Bengalgram (205) covering an area of 155.1 ha were implemented in the pulse growing districts of Karnataka and Tamil Nadu.

National Initiative on Climate Resilient Agriculture (NICRA)

During 2010-11, ICAR has launched a scheme on National Initiative on Climate Resilient Agriculture (NICRA) to take up strategic research and technology demonstration on climate resilient agriculture practices in the country. The scheme is being implemented with CRIDA, Hyderabad as lead institute under over all supervision of Division of National Resource Management of ICAR at 100 selected KVKs in different parts of the country.

Under Zone VIII, 9 KVKs viz., Kolar, Tumkur-A, Davangere and Belgaum (from Karnataka), Ramanathapuram, Villuppuram, Nagappatinam and Namakkal (from Tamil Nadu) and Alleppey (from Kerala) are successfully implementing the scheme. The major technological interventions includes popularizing suitable high yielding varieties / hybrids for the risk prone districts, adoption of farm implements through custom-hiring, establishment and maintenance of farm ponds, adoption of Integrated Farming System with livestock, poultry and fishery enterprises etc.

Interface Meeting

As per the suggestions from Secretary DARE and Director General ICAR, during the XXII Regional Committee Meeting held during May 2010 at Bangalore, two Interface Meetings were held, one at KAU Thrissur on 7th July 2011 and another at Thanjavur on 18th November 2011.

In the meeting held at KAU Thrissur, Honorable Minister for Agriculture Government of Kerala, Member of Legislative Assembly, Ollur Constituency, Government of Kerala, Deputy Director General (Agricultural Extension), ICAR, New Delhi, Vice-Chancellor KAU, Thrissur, Director Sugarcane Breeding Institute, Coimbatore, Director of Extension KAU Thrissur, Zonal Project Director, Zone VIII Bangalore and officials from State Departments, NABARD, Programme Coordinators of KVKs from Kerala, Self Help Group members and other officials from KAU and KVASU have participated. Major issues were deliberated in the Interface Meeting and it was decided to adopt Farmer First Approach in all the activities related to farmers in Kerala State.

In the meeting held at Thanjavur, Honourable Minister for Agriculture, Government of Tamil Nadu, Honourable Minister for Housing and Urban Development, Government of Tamil Nadu, Vice-Chancellor, TNAU Coimbatore, Directors of Extension TNAU Coimbatore and TANUVAS Chennai, Zonal Project Director Zone VIII Bangalore, officials from State Departments, NABARD, Programme Coordinators of KVKs from Tamil Nadu, Scientists from ICAR Institutes located in Tamil Nadu, and other officials from TNAU have participated. Many vital issues were deliberated and it was agreed upon for effective linkages between KVKs and ATMA and creating awareness among the farming community on various development schemes for farmers of both Central and State Governments.

National Farm Innovators Meeting

Farm Innovators Meet was organized at KVK Mysore during 12-13th November 2010. A total of 221 farm innovators from 25 states and 68 officials have participated in the meet. During the five technical session's viz., crop improvement, crop production, crop diversification, crop protection, and farm machinery, 104 farmers spoke about their innovation and shared their views. In addition, a total of 196 innovations of farmers were depicted through posters in the Farm Innovation Exhibition comprising of crop improvement (12), crop production (36), crop diversification (11), water management (13), farm machinery (68), crop protection (18), livestock and fisheries management (13) and post-harvest technology and value addition (25). More than 60 farm innovators displayed live specimen as well as models.

Agricultural Technology Information Centre

Agricultural Technology Information Centres were established with the objective of providing services to the farming community based on "Single Window System". The major services provided to the farmers are: i) technology services, ii) input services and iii) information services. At present there are 10 ATICs in Zone VIII.

Technology Services: During the reported period 123196 farmers as well as other personnel have visited ATICs. Out of them, 40459 visited for the purpose of technological advises and inputs and 36458 for study tour. Further 548 training courses were organized and provided analytical services to 21980 farmers.

Technological Input provided: Major technological inputs provided by the ATICs were seeds (13897.86 q), planting materials (594729 numbers), livestock strains (7748 numbers), bio-products (3388.01 q) and value added products 14782 packets, generating an income of Rs.6253.85 lakh.

Technological Information provided: ATICs have provided 62403 CDs/DVDs, 8302 books. Further ATICs have participated in 146 exhibitions, wherein 21.76 lakh farmers were exposed to modern technologies. In addition ATICs have replied to 11763 queries and gave 216 TV/Radio talks.

TAMIL NADU AGRICULTURAL UNIVERSITY

The Directorate of Extension Education (DOEE) is responsible for expeditious transfer of the latest technologies emanating from various research programmes of Tamil Nadu Agricultural University to the farming community and extension personnel. The following divisions are working under this directorate for effective transfer of technology activities in Tamil Nadu.

Krishi Vigyan Kendras (KVKs)

- Krishi Vigyan Kendras are functioning in all the districts of Tamil Nadu except Chennai and Tirupur. Out of 30 KVKs, 14 KVKs are under TNAU, three KVKs under TANUVAS, 11 KVKs under NGOs and 2 KVKs under Deemed Universities. Directorate of Extension Education has been entrusted the responsibility to provide technical backstopping to all the 30 KVKs in Tamil Nadu.
- In addition to the regular KVK mandated activities, NICRA project has been sanctioned to four KVKs in Tamil Nadu (Villupuram, Nagapattinam, Ramanathapuram and Namakkal) and the programme has been successfully launched in all four centres.
- Recently occurred Thane Cyclone on 30th December, 2011 has devastated Cuddalore and Villupuram districts for which a separate proposals seeking financial support has been submitted to ICAR for taking corrective measures for repair, renovation and rehabilitation works in these areas.

- Interface Meeting of KVKs with all stakeholders was organized on 18-11-2011 at Tanjore to bring synergy and convergence in agriculture by involving all the stakeholders including Minister for Agriculture, APC & Secretary, Commissioner of Agriculture, agriculture and line department officials, NGOs, programme coordinators of KVK and farming community.
- Intensive multiplication of Papaya Mealy bug parasitoids was undertaken in all the KVKs and supplied to farmers free of cost. Because of this intervention, papaya mealy bug was successfully controlled in Tamil Nadu.

Training Division

The Training Division was established in late 80s with the objective of imparting training to the officials of Development Departments and the NGOs. Trainings to extension personnel are being conducted on 36 important topics. Trainings are also being organized for the benefit of farm women and self-help group members on 23 agriculture and allied topics. Training to probationary Deputy Collectors and Deputy Registrars of Cooperative Societies are also organized through the Training Division. Training on agriculture and allied enterprises are also organized for the benefit of Panchayat Presidents and Councilors in collaboration with Department of Rural Development, Govt of Tamil Nadu.

Department of Market Extension

Market Extension Department was established with the objectives of formation of Commodity Groups of farmers, providing technical guidance on production and marketing, arranging Buyer-Seller Meets, building the capacities of the personnel involved in Government Marketing Directorates, providing the prices of commodities to farmers for enabling them for efficient marketing, Organising melas for empowering them on efficient marketing etc.

Stakeholders involving Commodity Groups of Horticulture crops of Coimbatore District, Buyer-Seller Meets for the fruits and vegetable growers across the state, Capacity Building programmes on Production and Marketing to the Joint Liability Group members promoted by NABARD, Entrepreneurial training on production and marketing of oilseeds and pulses to the growers across the state, Organising a mega GOI sponsored Regional Agricultural Fair under the theme "Market-led Agriculture" involving all the Southern States, coordinating all the Fairs involving CIG members and KVKs under Public-Private Partnership mode, Organising capacity building programmes for the Marketing Department Personnel, providing the daily markets prices to thousands of farmers thro" DMI, Organising exposure visit of farmers to leading markets etc. are the activities of Market Extension Department. Training programme on Agricultural Marketing Awareness in collaboration with National Institute of Agriculture Marketing, Jaipur was also undertaken for facilitating efficient marketing of agricultural commodities.

State Agriculture Management and Extension Training Institute (SAMETI)

State Agricultural Management and Extension Training Institute was established at TNAU as an autonomous institute to give technical backstopping to ATMA and Extension Reforms programmes in Tamil Nadu. The key activities are:

- Intensive training programme on technical and managerial skills to the State Department of Agriculture and line department officials.
- Training for newly appointed Agriculture Officers under Macro Management Mode training programme.
- Two training programmes for District watershed technical team with help of DPAP programme. 63 trainees participated in the two training programmes.
- Gender Sensitization Module to cutting level extension functionaries was organized with

financial support from National Gender Resource Centre in Agriculture, Dept. of Agriculture and Cooperation, GOI at 14 KVKs of Tamil Nadu.

- Post Graduate Diploma in Agricultural Extension Management programmes and other training programmes were also organized in collaboration with MANAGE, Hyderabad.

Other Important DEE Activities

State Level Farmers Day: The Directorate of Extension conducts state level farmers day at the University campus to show the results of new experiments on various aspects of agriculture to the farmers and to get their feedback about the on-going research programmes. AGRI-INTEX programme was also organized at International level in collaboration with CODISSIA, Coimbatore. Agri-Horti Fair and Agri Fair were also organized at Coimbatore with support of local private agencies to create awareness about latest agricultural technologies among the farming community.

State Level Seminar on Attracting Youth towards in Agriculture: was organized on 29th December 2011 at TNAU to sensitize the youth and to retain in agriculture activities.

Agricultural Technology Information Centre (ATIC): ATIC as a single window delivery system provides agricultural information, products and technologies developed by the University to the farmers. It is also rendering services to the visiting farmers through advisory services. In addition, farmers with plant clinic problems are also attended with suggestions on suitable management measures.

Community Radio Station: Instantaneous information on weather, market prices, forecast for sowing in relation to marketability etc., are being broadcast apart from the technical guidance by scientists, experiences of farmers form the broadcast content of every day. One such Community Radio Station was established in TNAU during 2010 and this Radio is functioning as "Velaan Palkalaikkazhaga Vivasayee FM" at 107.4 MHz frequency for 3 hours by which around 10,000 farm families residing in 22 villages around TNAU campus are benefitted.

A proposal for expanding the community Radio service by establishing Community Radio Stations in 28 districts of TN at an outlay of Rs.14.00 crores has been submitted to the Ministry of Information and Broadcasting, Govt. of India for approval.

Kisan Call Centre (KCC): This centre functions on all working days between 7.00 A.M. and 10.00 P.M. The Directorate of Extension Education acts as the Nodal Agency which imparts the training on modern agriculture and allied sectors to the personnel of KCC.

Uzhavarin Valarum Velanmai: 'Uzhavarin Valarum Velanmai' a monthly Tamil Farm magazine of TNAU, Coimbatore is published by the Directorate of Extension Education, since 1975. The reader's base is very large and diverse and the total subscribers of the magazine about 13,000.

INSIMP: Under this project, 25 Pre-Processing and Processing small units were installed in 25 locations to promote millets for nutritional security.

E-Extension Centre

Precision Farming Project: With the support of NADP (RKVY) funding from 2007 – 08 up to 2010 – 11, an area of 50, 000 ha was brought under Precision Farming Project in the Tamil Nadu. As each farmer was allotted one unit only (one ha), almost all the farmers have extended the Precision Production System with their own investment for the rest of the land they possessed and also availing the subsidy under micro irrigation scheme. Many of the projects are *subsidy driven* and few are *technology driven* but the Precision Farming Project became the 1st project to be termed as *farmer driven*. *Training to all the beneficiary farmers were organized by TNAU training centres*. Cluster level associations and farmers producer company have also developed under this project for empowerment of the farming community.

Agritech Portal (<http://agritech.tnau.ac.in>): Dynamic portal holds around three and half lakh pages in Tamil and English with multiple media content. The Portal has been dedicated to service on 27th Sep, 2009 for the benefit of field extension officials and other stakeholders. As on date the Total Viewers of portal is 6,52,345, Daily Visitors 450 (approx.), Average time on Site 12-18 minutes, Number of page hits / day 35-60 pages, e-Mails Queries 1865, New Visitors / day 125-140 (approx.) and Updating is on daily basis. Now Government of Tamil Nadu has taken up the portal initiative as flagship programme under National e-Governance and Tamil Nadu State e-Governance. TNAU agritech portal has also been awarded best e-governance agri portal by Government of India.

TNAU Agri tech Portal: The main HUB (TNAU, Coimbatore) is being connected with the 60 Centres of TNAU (14 KVKs + 36 RRS/ARS/HRS + 10 Colleges) for information sharing and exchange. Regular interaction meetings between scientists, farmers and extension workers are being organized through this video conferencing facility.

Dynamic Market Price Information for Agri-Horti Produces (www.indg.in / www.tnau.ac.in): Dynamic Market Information for 13 important south Indian markets namely Chennai, Bangalore, Coimbatore, Mettupalayam, Hosur, Thalaivasal, Trichy, Kumbakonam, Madurai, Tirunelveli, Oddanchathiram, Cochin and Panruti for 153 commodities are being uploaded regularly in the web. The market price information is also being sent to 42000 farmers through mobile. Major traders database has also been uploaded in the website.

Expert System for Agriculture and Animal Husbandry: Under ICAR Network project on development of expert system for agriculture and animal husbandry, expert System for Paddy, Banana in Precision system, Coconut, Ragi and Sugarcane have been developed in English and Tamil versions. Translation into Malayalam and Kannada work is going on. Expert system for animal husbandry is also being developed in the above languages.

NAIP – Development of ICT Tools / Technology towards an interactive multimedia based agro advisory system: An interactive multimedia based agro advisory system is being developed with partnership of IIT, RTBI, Chennai and partners from Dharmapuri Precision farm agro service limited, Erode Precision farm producers company limited and National Agro foundation. Individual farm historian database for 1200 farmers were created. Software for providing mobile based agro advisory service is also being developed and will be integrated with farm historian database for providing farm specific agro advisory service.

NAIP Mass Media for sharing agro information: Video module on Dutch Rose in open field cultivation, Ultra hi-density mango cultivation, Organic farming, turmeric processing technologies were developed. Innovative and successful technologies were also scouted and published in the leading newspapers with the help of reputed farm journalists.

TNAU – Nokia Project on Harness Mobile Technology in Agriculture: The project was successfully implemented during 2010-11 in collaboration with Nokia Research Centre, Bangalore. Nokia Kisan software was developed and tested in the farmer's fields to give push and pull service of mobile agro advisory to farming community via Nokia ovi life tools.

TNAU – IFPRI Knowledge Portal: TNAU e-extension centre has also developed exclusive Knowledge portal for advancing agriculture production and productivity for the Indian farmers in collaboration with IFPRI. Location specific information for Thanjavur and Tiruvarur, national technologies and global technologies were also loaded in this portal (<http://www.wiki.tnau.ac.in>)

TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY, CHENNAI

The following technologies for various crops being introduced by KVK, Kundrakudi which are being accepted and adopted by the farming community.

Paddy

- Eco-friendly Economic Threshold Level (ETL) based Integrated Pest Management (IPM)
- Integrated weed management in transplanted rice
- Weed management in direct sown paddy
- Management of Bacterial Leaf Blight (BLB)
- SRI method of planting
- Management of Rice Blast disease

Maize

- Introduction of hybrid maize

Cotton

- Control measures for mealy bug

Groundnut

- Management measure for root rot disease
- Integrated Crop Management (ICM) practices

Blackgram

- Introduced short duration high yielding pest and disease resistant variety CO (BH)-1

Success of new crop rotations

- *Traditional crop rotation:* Groundnut (January – March) - Paddy (April – July) - Paddy (August–December)
- *New Crop rotation (KVK Developed):* Maize (April - July) – Paddy (August - December) - Blackgram (January - March)

This new crop rotation achieved more net income compared to traditional crop rotation at KVK, Kattupakkam. KVK, Kundrakudi popularized silvipastoral system with livestock integration in dry land ecosystem and it is being successfully followed.

Equipments introduced

- New Table Top Paneer Pressing device for making paneer in an easy way.
- Manually operated low cost milking machine for dairy cows and
- Groundnut harvester as drudgery management measure

Popularity of new strains / species in cattle /poultry/fisheries

Popularization of the following strains of birds and fish are being carried out by KVK, Kundrakui which received wider acceptance among people for its commercial value includes,

1. CARI Asel birds
2. Quail birds
3. Scampi/fresh water prawns
4. Cat fish: *Pangasius pangasius*

Efficacy of new programme in Extension Education

- KVK, Kattupakkam established Village Knowledge and Information Centre (VKIC) at Thalambedu village of Kancheepuram district for the benefit of farming community, rural youth and school children to access the information on agriculture and animal science technology through computers and internet connectivity.
- KVK, Kattupakkam developed Public Private Partnership (PPP) Mode Programme to procure agricultural seeds, livestock and poultry chicks from the farmers and benefited to the other farmers by an MOU between KVK and Successful farmers.

Public Private Partnership model in fodder seed production and supply has been initiated by Krishi Vigyan Kendra, Namakkal. 32 farmers have signed in the Memorandum of Understanding with KVK, Namakkal to produce CoFS-29 multi cut Fodder Sorghum, Hedge Lucerne, *Stylosanthus*, *Cenchrus ciliaris*, *Sesbania* and Subabul seeds.

UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

- Under the Integrated Farming System Demonstration project, the University has selected 141 villages from 15 taluks and identified 25,000 beneficiaries including agricultural labour. Improved seeds of paddy, pulses, vegetables & green manures, seedlings of fruits, hybrid fodder, multi cut fodder & multipurpose trees, bio-fertilizers, seed treatment chemicals, micronutrients, rock phosphate, press mud, and gypsum were distributed.
- Units under Directorate of Extension such as KVKs, Extension Education Units, Farmers' Training Institute, Staff Training Unit, Bakery Training Unit, ATIC trained 34976 farmers and 2710 extension personnel. The units have also conducted 1784 frontline demonstrations, 411 on-farm testing, 110 method demonstrations and 24579 advisory services during 2010-11.
- During 2011-12 they have trained 32,228 farmers and 2695 extension personnel through 783 training programs. The units have also conducted 1639 frontline demonstrations, 664 on-farm testing, 67 method demonstrations and 5173 advisory services.

Other State government Programs

- UAS Bangalore is implementing development of SC farmers in 17 Southern Districts through "Integrated Development of SC families through adoption of Integrated farming systems under SCP & Integrated Development of ST families through adoption of integrated farming Systems under TSP" funded by Government of Karnataka.

National Krishimela-2011

- University has organized National Krishi Mela for the first time at GKVK campus during November 16 - 20, 2011 where more than 10 lakh farmers participated different States.
- Fruits and Vegetable Marketing Complex was Inaugurated at KVK, Hadonahalli, Bangalore Rural district on 11th February 2011.

UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

- **Participated in the following exhibitions**
 - National Level Exhibition “Horti-Expo 2010” at Post Graduate Centre, Bengaluru organized by the UHS, Bagalkot from 27th to 30th May 2010
 - Krishi Ustava of Gadag district and exhibition on agriculture and allied aspects from 31st March 2010 to 2nd April 2010.
 - JSS Suttur Jatra Mahostav, Mysore from 31.01.2011 to 04.02.2011
 - Sri Thontadarya Jatra Mahostav, Gadag and exhibition from 16th to 19th April 2011 on Agriculture and allied aspects
 - Krishi Vigyan Mela at Pusa, New Delhi from 3-5 March, 2011. A team of seven *Shreshtha krushika* and seven *Shreshtha krushi Mahile* awardee farmers and farm women were taken to Pusa, New Delhi to participate in Krishi Vigyan Mela.
 - Six Krishi Utsavas each in Bijapur, Bagalkot and Haveri districts and exhibitions on agriculture and allied aspects.
 - Dharwad Ustava and exhibition on agriculture and allied aspects at Karnataka college, Dharwad
- Organized 14 training programmes for farmers including one State Level Training programme on Management of Post-Harvest Technologies and Value Addition for progressive farmers of Raichur district.
- Organized Orientation-cum-Review Workshop on Implementation of Modified Extension Reforms Scheme under SAMETI (North) at Dharwad. Nearly 750 Extension functionaries participated.
- Organized State Level seminar on Management of Rhizome Rot of Ginger at Hallikoppa village of Sirsi taluka on 18th September 2010.
- A mega event - Krishimela-2010 organized at Main Campus, Dharwad from 2 – 5 October, 2010. Nearly 7.4 lakh farmers / farm women / extension functionaries / representative of NGOs / representative of private enterprises participated
- Organized Rabi/Summer Kisan Mela – 2011 on 7th March 2011 at Dharwad to educate the farmers about the *Rabi / Summer* crop production technologies and nearly 5000 farmers / farm women / extension functionaries participated in the mela.
- Organized State Level workshop on Recent Advances in Sugarcane Production Technologies for sugarcane growers of Karnataka from 28.02.2011 to 01.03.2011.
- Conducted a farm school on Wheat Production Technology by organizing Demonstration on Performance of wheat varieties at Marewad village of Dharwad taluka under ATMA.
- 1466 programmes on Agriculture were broadcast through Krishi Community Radio Station, UAS, Dharwad
- Project on “Planet Earth” was sanctioned for an amount of Rs.7.28 lakhs from DST, New Delhi to record 365 episodes on various activities of Planet Earth project. These episodes will be broadcast through Krishi Community Radio Station, UAS, Dharwad.
- As a part of efforts for capacity building of extension functionaries SAMETI (North), organized three exposure visits to AP, TN & Maharashtra during 2010-11 for 120 officials from line Departments of Agriculture and allied sectors.
- Under RKVY project - farmers fellowship programme, 18 trainings were organized for 502 farmers on various aspects.

UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT

Status of varieties of seeds/ planting material released in the last three years

The University of Horticultural Sciences, Bagalkot has released three varieties namely Bhagya (KDM-01) in drumstick, Apoorva in Capsicum and Kalpataru in coconut. The status of the above varieties is as follows:

Crops	Variety	Seeds/ Planting material sold	Seeds/ Planting material available	Remarks
Coconut	Kalpataru	16080 seed nuts 7636 seedlings	40,000 seed nuts 20,000 seedling	Popular & accepted by farmers
Capsicum	Apoorva	1.0 kg seed	2.0 Kg seeds	Needs popularization
Drumstick	Bhagya (KDM-01)	5155 seedlings 124.2 kg seeds	10,000 seedling 200 kg seeds	Popular accepted and adopted by farmers

Package of practices

- University of Horticultural Sciences, Bagalkot is revising and developing package of practices for vegetables, fruits, flowers, plantation crops medicinal and aromatic crops taking into account of what has been done by different R & D institutions.

Success or failures of new crop rotation/ cropping sequences / mixed cropping etc.

- Pomegranate - sapota cropping sequence was the most popular in the district of Bagalkot since time immemorial. However, because of bacterial blight of pomegranate this sequence is a failure now.
- Sugarcane used to be rotated with cotton. The farmers are not going for cotton. Instead they go for maize or sunflower.
- Arecanut is affected by yellow leaf disease (YLD) in Sringeri, Koppal and NR Pura of Shimoga district. Besides working for remedial measures, alternate crops are being suggested.

Performance of equipment and machinery introduced

Coconut tree climbing equipment, snow ball tender nut machine, tender nut cutter and punching machine developed by CPCRI are introduced in the traditional coconut growing areas of Karnataka. The farmers need to be educated for populating these equipments.

Efficacy of new programmes in Extension Education

The new programmes in Extension Education are attracting the rural youth for ex. e-extension is having good impact. The flagship programmes like IFS demonstrations, Bhu-chetarn are found to be creating positive impact.

CHAPTER XII

STATUS OF NATIONAL AGRICULTURAL INNOVATION PROJECT

National Agricultural Innovation Project (NAIP) funded by the World Bank, was approved on April 18, 2006 and became effective for implementation on September 18, 2006 with closing date as December 31, 2012 which has been extended up to 30th June, 2014. NAIP is being implemented by ICAR with a budget outlay of US\$ 250 million. Besides this, US\$ 7.37 million is granted for the Sustainable Land and Ecosystem Management Programme under the Global Environmental Facility.

Two approaches viz., competitive mode and sponsored mode were used in inviting, peer reviewing and approving sub-project proposals. First the concept notes (CNS) were invited and then the full proposals were invited for approved concept notes. The sub-projects under component- 1 were processed under sponsored mode.

To address project objective, research agenda is divided into four components in which, 188 consortia leaders and 646 consortia partners are participating, adding up the number of participating institutions to 834. In this Zone NAIP sub projects costing Rs.16777.82620 lakhs are operating at 167 centres.

Objectives of the NAIP

The overall objective is to contribute to the sustainable transformation of Indian agricultural sector from an orientation of primary food self-sufficiency to one in which a market orientation is equally important for poverty alleviation and income generation. The specific objective is to accelerate the collaborative development and application of agricultural innovations between public research organizations, farmers, private sector and other stakeholders. The specific objectives envisaged are:

- To build the critical capacity of the ICAR as a catalyzing agent for management of change in the Indian NARS (Component- 1).
- To promote 'production to consumption systems research' in priority areas/ themes to enhance productivity, nutrition, profitability, income and employment (Component- 2).
- To improve livelihood security of rural people living in the selected disadvantaged regions through technology-led innovation systems, encompassing the wider process of social and economic change covering all stakeholders (Component- 3).
- To build capacity to undertake basic and strategic research in frontier areas of agricultural sciences to meet challenges in technology development in the immediate and predictable future (Component- 4).

Overall, the project progress is satisfactory as revealed through the performance indicators, viz. development of 91 public private partnerships, piloting of 50 rural industries, filing of 29 patent / intellectual property protection applications, publication of 222 research papers in high impact peer reviewed journals, international training of 346 scientists in frontier areas of sciences and 236 scientists in the consortia, establishment of ten BPDs, development of 69 production technologies, 80 processing technologies and 105 novel tools / protocols / methodologies for research and commercialization of 28 technologies.

MAJOR ACTIVITIES AND ACHIEVEMENTS

Component – I

Development of e-courses

Based on knowledge management, modern education cannot be imagined without digital technologies and it can be stated that the role of e-courses are of immeasurable importance. Though, it does not replace the traditional teaching, it diversifies and complements the traditional teaching processes. Computer-based e-learning courses are the major initiatives of ICAR under Component-1 of NAIP. Seven e-courses in the field of Agriculture, Horticulture, Veterinary Science and Fishery Science have been started for the bachelor's degree programmes. All these courses are uniformly based on a e- learning platform called Moodle. The following courses were developed in this zone.

S. No.	Name of the Courses	Total Courses	Delivered	Lessons Prepared
1.	B.Sc. (Horticulture) Degree Programme	51	45	1353
2.	B.F.Sc. degree programme	54	45	1380
3.	B. V.Sc. & AH Degree Programme	69	69	3000
4.	B.Sc. (Agriculture) degree programme	50	14	Entire courses will be given by NDRI by 31 st May, 2012

Business Planning & Development (BPD)

- The ZTM-BPD Unit, South Zone has provided technical consultancy to Horizon Fisheries Pvt. Ltd., and Mandhoo Fisheries Complex, Mandhoo, Republic of Maldives in the area of thermal validation of seafood. The scientific team from CIFT visited Maldives and conducted thermal validation studies during the period 23rd April to 2nd May 2011. The team also provided training to the management and technical staff of the company on various aspects of thermal process validation, retort operation and optimization of process for thermal processing of products from tuna in retortable pouches and rigid cans.
- BPD-TNAU has successfully signed Technology transfer MoUs with six companies / entrepreneurs during the period.
- BPD-TNAU has bagged a new project titled "Establishment of Technology Business Incubator (TBI) at Tamil Nadu Agricultural University" funded by the Department of Science and Technology, Government of India to the tune of Rs 192.87 lakhs for five years .

Establishing and Networking of Agricultural Market Intelligence Centre in India

Networking the production centres and markets through ICT is one of the strategies for taking the Indian farmers to the global markets and raise to the global standards. Marketing Intelligence plays a crucial role in enhancing the farmer's income. ICT is a major tool for this purpose. While modernizing the existing markets, use of ICT is one of the strong components for brining transparency in the marketing activities and improving the marketing efficiency. The following achievements were made in this area.

- 182 commodity price forecasts for 36 commodities were made and disseminated for the benefit of farmers through various media across the country.
- National Informatics Centre has made a valuable impact by creating a price behavior icon in the homepage of Agmarknet website in which market advisories and price forecasts given by market intelligence centres of the sub-project are linked.
- Voice SMS via IFFCO Airtel , to around 24 lakh Green card holders and regional text SMS through NOKIA Life tool Services in Agriculture is provided with validity of more than 92 %.
- The forecasts are being used by a larger section of the farmers throughout the 10 States in taking sowing decisions and selling/storage decisions. Results of the impact study revealed that Rs. 100s crores were additionally earned by adopted farmers of turmeric and cotton with the pre harvest forecast.
- In the state of Karnataka, based on the forecasted price, Govt. of Karnataka gave a bonus of Rs. 500/quintal. Similar impact studies are available in the different partner centres.
- Commodity reports have been prepared for 18 commodities

Development of ICT Based Tools / Technology towards an Interactive Multimedia Agriculture Advisory System

Sensitized project farmers on mobile based agro advisory services through awareness and technical workshops conducted at many places. This Project covers 1200 farmers from 3 districts in Tamil Nadu (Kancheepuram, Erode and Dharmapuri).

Component – II

Research on production to consumption system is covered by 51 consortia working across the sub-sectors of Indian agriculture. Some of the value chains identified include medicinal and aromatic plants, bio-fuel crops, poultry, fruits and vegetables, fisheries, food grains and oilseeds, plantation crops, livestock products, natural dyes and agro forestry. A good number of consortia have developed market driven technologies, process protocols and products which have shown positive impact in terms of income and employment generation, value addition and strengthening of weak chains. Some of them are:

- Improved production and packaging technologies of jasmine which enhanced income of farmers and increased flower export to Dubai and US markets
- Improved production technology of marigold which enhanced profit due to increase in xanthophyll content
- Briquetting technology of plantation residues of casuarina and the industrial residues of matchwood species promoted through agroforestry
- Development of three new ginger products, viz. NR Ginger, > 30% Gingerols and > 20% Gingerols in free flowing powder form for commercialization
- Millet based value chains have created wider awareness among the consumers and its intake in diet reappeared and
- Value-chain of banana pseudostem providing employment and income generation.

Component – III

Livelihood security of rural poor living in selected disadvantaged districts of Karnataka, Kerala and Tamil Nadu are being addressed through four subprojects under component 3 (Research on sustainable rural livelihood security) of NAIP. It includes Cuddalore, Thiruvannamalai, Nagapattinam and Villupuram (TN), Chitradurga and Bidar (Karnataka) and Wayanad (Kerala). Some of the successfully demonstrated interventions for enhanced livelihood were as follows:

1. Integrated Rice - Fish - Poultry Farming System in wetland clusters of Tamil Nadu
2. Redgram transplanting in Bidar
3. Ornamental fishery in Chitradurga
4. Breed improvement of goats through Osmanabadi bucks in Bidar
5. Organic farming of coffee and pepper in Wayanad
6. Rejuvenating area under paddy crops by recouping banana and tapioca fields in Wayanad
7. GI registration of Wayanadan Scented Rice Varieties – Jeerakasala & Gandhakasala
8. Enhanced onion productivity by improved variety and micronutrient application in Chitradurga
9. Arecanut slicing and chipping machine, and leaf plate making machines were introduced in Chitradurga for enhanced income.

Marketing model

Vegetable and Fruit Promotion Council, Keralam (VFPCCK) model was successfully introduced by RRS KAU, Wayanad for marketing of farm produce under the subproject. In all 15 collection points (farmer owned markets) and one retail outlet for the collection and marketing of farm produce for increased profit to the farmers. Through these outlets 1273 of produce worth Rs.1.92crore have been traded.

Krishi Sandesha

SMS related to Agriculture, Veterinary, Rainfall etc. are being sent to 2600 farmers since 29th July, 2009. As per farmers' feedback, they gained benefit, like Timely Fertilizer application, Right time sowing, Pest and Disease management, Information about disease management in Livestock animals, Weather forecasting, Market price, Information about trainings at Krishi Vigyan Kendra and other line departments, Timely testing of soil and water and Usage of improved variety seeds and other management practices by receiving "Krishi Sandesha".

Synergy with ongoing programmes

Under NAIP, emphasis is laid on synergy with ongoing programmes. As estimated more than Rs 2.5 crores of funds were mobilized through NABARD; Salasamvardhana; SELCO; State Departments of Agriculture, AH and Horticulture and Department of Minor Irrigation for support in the NAIP villages. This shows acceptability of NAIP interventions. Annamalai University has organized interaction meeting between stakeholders and leading bankers for credit facility on rice – fish - poultry intervention.

Component – IV

Animal Health

- **Bovine Mastitis: molecular details of host-microbe interaction and molecular diagnostic methods:** A biochip capable of detecting mastitis-causing pathogens and specific virulence genes has been developed. Gradual increase in expression levels of immune related genes was seen from 4h to 24h whereas after 48h of infection, there was drastic increase in the expression level of all these genes.
- **Toll-like receptors in farm animals:** Lack of clinical disease in buffalo to the *Peste des petits* viral disease has been attributed to higher production of interferon in buffalo peripheral blood mononuclear cells (PBMCs) causing decreased replication of the virus. Mechanism of differential susceptibility of goat and buffalo ruminants has been established.

Rumen Physiology and Ecology

- **Rumen microbial diversity in domesticated and wild ruminants and impact of additives:** Feeding trials showed that ajowain oil can be used as growth promoter. Feed supplementation with suva, kulthi and babul @ 2% on dry matter basis showed potential to mitigate methane production without affecting digestibility of feed.
- **Rumen ecosystem for improved utilization of crop residues:** *In-vitro* trial with recombinant yeast *Saccharomyces cerevisiae* containing exoglucanase has been conducted to assess dry matter digestibility of the recombinant yeast cultures.

Biodiversity

- **Variability in freshwater bivalves in the Western Ghats:** A field key for taxonomic identification of the genera, *Lamellidens* and *Parreysia* based on morphological and morphometric characters and a digital key using visual basic programme were developed. Species-wise abundance of each species in different riverine systems of Western Ghats has been mapped.

Abiotic Stress Tolerance in Agriculture

- **Effect of abiotic stresses on natural enemies of crop pests and mechanism of tolerance:** Stress tolerance in the parasitoid *Trichogramma chilonis* strains was attributed to the involvement of additional alleles of carboxyl esterase and higher enzyme level of carboxyl esterase. Yeast species, *P. anomala*, *M. reukaufii*, *Z. rouxii* and *C. apicola* had significant role in enhancing its fitness attributes (parasitism and fecundity). Two bio-pesticides have been licensed for commercialization, viz., (i) An insecticide tolerant strain PTS-8 of *Chrysoperla zastrowi sillemi*, having tolerance to different groups of pesticides, and (ii) A *Trichogramma chilonis* strain TcT1E, an egg parasitoid used successfully as inundative biological control agent against a range of agricultural pests, having high level of tolerance to endosulfan.

Resistance to Biotic Stresses in Agriculture

- **RNAi as a model in silencing genes specific to tomato fruit borer, *Helicoverpa armigera*:** A full length VATPase A gene has been cloned and sequenced from *H. armigera*. Technology for efficient dsRNA synthesis *in vitro* has been developed and dsRNA synthesized *in vitro* for VATPase A, B and C subunits. Validation of silencing of serine protease gene by dsRNA@10ug showed more than 95% efficacy.

Structures and Processing Engineering

- **Standardization of selected ethnic fermented foods and beverages:** Instant idli dry mix technology (shelf-life of over 4 months) with dry form culture has been developed. Rice varieties like White Ponni, Co 43, IR 20, ADT 36, BPT, Sona masoori and Kranti are suitable for Insta dry mix. ITS region of the yeast strains responsible for preparing rice beer were amplified and phylogenetic tree based on the ITS region constructed.

National Trainings and International Trainings

One hundred and two scientists of this zone were trained abroad in the different frontier areas of agricultural sciences. In various organizations of this zone, 26 national trainings (with resource person from abroad) were organized to train 16 scientists in each area. A large number of scientists have been trained abroad in various consortia of NAIP Sub-projects running in this zone.

S. No.	Area	National Trainings organized	Scientists Trained Abroad
1.	Allele Mining	2	7
2.	Apomixis	1	-
3.	Bioinformatics	3	9
4.	Biomolecules	1	7
5.	Bioremediation	1	2
6.	Biosecurity	2	3
7.	Carbon Trading/Carbon Sequestration/Climate Change	1	4
8.	Fermentation Technology	-	4
9.	Genome Resource Conservation	1	3
10.	Microbial Molecular Taxonomy	1	3
11.	Molecular Diagnostics	2	3
12.	Mitigation Strategies for Methane Production from Livestock	1	1
13.	Molecular Breeding	1	4
14.	Nanotechnology	1	4
15.	Nutraceuticals	-	7
16.	Non chemical/Non Thermal processing and Membrane technology	1	7
17.	Sensor-based Applications including bio-indicators	--	3
18.	Stem cell Research	1	5
19.	Smart packaging	1	1
20.	Intellectual Property Rights	4	5
21.	Marker Assisted Selection	--	18
22.	Transgenic Animals	--	2
23.	Nutrient Use Efficiency	1	-
	Total	26	102

CHAPTER XIII

PROCEEDINGS OF THE XXIII MEETING OF THE ICAR REGIONAL COMMITTEE NO. VIII HELD AT COIMBATORE DURING 15 - 16 JUNE 2012

The XXIII meeting of ICAR Regional Committee No. VIII was held at Coimbatore during 15th & 16th June 2012. The inauguration was held at the Anna Auditorium of Tamil Nadu Agricultural University and the Technical Sessions were held in the Seminar Hall of the RI Building, TNAU. The meeting was attended by Vice Chancellors, Directors of Research, Directors of Extension Education and Deans of the Agricultural Universities; Directors / Dy. Directors of Agriculture / Horticulture and Animal Husbandry from Tamil Nadu, Karnataka and Kerala; Deputy and Assistant Directors General from ICAR, Directors of ICAR Institutes / Zonal Project Director, Project Coordinators, Heads of Regional Stations / Research Centres of ICAR Institutes, Representatives from NABARD and a number of prominent agricultural scientists from Tamil Nadu. List of participants is given in Annexure-I.

Dr. P. Subbian, Registrar, Tamil Nadu Agricultural University & Acting Vice Chancellor, TNAU welcomed the gathering and thanked ICAR for having agreed to hold the meeting at TNAU. He briefed about the major achievements of TNAU in agricultural research, extension and education. In his welcome address, Dr. K.D. Kokate, DDG (Agril. Extension) and Nodal officer, Regional Committee No VIII said that the meeting is important for preparing a regional plan for development. The biennial meetings would help to identify location specific problems in Agriculture, Horticulture, Animal Husbandry and Fisheries in the region and evolve solutions for these problems. In his Introductory Address, Dr. S. Ayyappan, Secretary, DARE & Director General, ICAR highlighted the importance of Regional Committee meetings in resolving regional issues related to Agriculture, Horticulture, Animal Husbandry and Fisheries. He outlined the major initiatives taken up during the XI Plan period in various sectors which include the NICRA project, Pulses demonstrations etc. There had been many success stories from the region like SRI in Tamil Nadu, homestead farming in Kerala, management of sugarcane woolly aphid and papaya mealy bug and the egg production in Namakkal. But there are core areas of concern like static productivity in most crops, persisting problems like coconut wilt, shortage of green fodder, non-availability and high cost of labour, escalating cost of cultivation etc. He also mentioned that there is an urgent need to strengthen farm mechanization to keep agriculture profitable and sustainable. During XII Plan, focus will be on dry land agriculture, highland agriculture, disaster management, agro tourism / eco-tourism, disease management, climate resilient agriculture etc. Steps are to be taken to check the migration of youth from rural areas by making agriculture sustainable and more remunerative.

Shri S. Damodaran, Honorable Minister for Agriculture, Tamil Nadu presented awards to the Tamil Nadu Veterinary and Animal Sciences University, Chennai for the best performing NAIP Project. Shri Karuppaiyan, a progressive banana farmer from Tamil Nadu, was presented the best farmer award by the Minister. The minister also released the following publications and products from SAUs and Institutes during the occasion.

1. Hi-tech cultivation of spices – in Tamil (TNAU)
2. Book on Agro- ecological Zone Map of Tamil Nadu and CD on Delineation of Agro – ecological Zone of Tamil Nadu (NBSS&LUP)
3. CD on e-courses for B.V.Sc. & A.H. degree Programme (TANUVAS)
4. Production Technology of Tropical Fruit Crops - A Hand book (IIHR).
5. CIFT semi pelagic trawl system – An ecofriendly alternative to bottom trawling for small scale mechanized sector (Hindi version)

6. CIFT Advisory Series and Fishing methods of Chilka Lagoon – CIFT information series.
7. Inventory of Recent Animal and Fisheries Technologies for Karnataka (KVAFSU, Bidar)
8. Integrated Fish Farming System – video documentary.
9. Packets of mineral mixture for small ruminants (sheep and goat) - NIANP Bangalore

The Hon'ble Minister for Agriculture, Government of Tamil Nadu in his inaugural address said that over 90% of the farmers are marginal and small farmers and the research efforts should address their problems. He said that agricultural education should focus on imparting practical knowledge and providing skills in market led extension and entrepreneurship development, so that they can serve the farming community better. He also highlighted the need for crop planning based on market intelligence to ensure good returns to the farmer. He stressed the need for reducing post harvest losses which runs to several crores of rupees. The agricultural sector is facing shortage of labour, which is likely to become more acute in the coming years. Research Institutions should develop cost effective and user friendly machines that can save labour.

The Minister expressed serious concern on the depletion of water resources. In Tamil Nadu, the estimated water availability by 2025 is 4.74 million ha as against the requirement of 6.20 million ha, which is short by 31%. There is an urgent need to develop water saving technologies. The Minister suggested that ICAR should intensify research on climate resilient agriculture, soil based cropping system, mechanization, post-harvest management etc.

Dr. N.V.Nair, Director, Sugarcane Breeding Institute, Coimbatore and Member Secretary, ICAR Regional Committee No. VIII proposed a vote of thanks.

The Technical Sessions were held under the chairmanship of Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR in the Seminar Hall of TNAU. After a brief introduction of the participants, the Chairman invited Shri Ullas Menon, Secretary General, UPASI for a brief interaction. Mr. Menon gave an overview of the plantation crops scenario in the region. In crops like tea, the production cost is higher than the price realized from the produce. Labour cost and availability being a serious issue, there is an urgent need for mechanization. The cost of production has gone up and unless there is significant improvement in mechanization, the cultivation of plantation crops cannot be sustained. He also mentioned about the Gadgil Committee's Report on Western Ghat ecology recommending that the pesticide and weedicide application in Zone I (Karnataka and Tamil Nadu) has to be stopped gradually in the next five years. This could have a serious impact on plantation crops cultivated in the region. The Chairman informed that Tea, Coffee, Rubber and Silk are not dealt by ICAR directly but by the respective commodity Boards. However, often various agencies write to ICAR seeking expert advice on these crops on various issues. Hence, there could be some areas of collaboration in dealing with the problems.

As per the suggestion of the Chairman, the Action Taken Report on the recommendations of the 22nd RC meeting was approved by the Committee. Shri S. K. Bhargava, Member, Governing Body, ICAR pointed out that the ATR from some of the Centres has not been received. The Chairman requested all Members to provide the ATRs in time. Thereafter, the Chairman invited the views of the various State departments on developmental issues. Shri M.G. Mohammed Iqbal, Deputy Director of Agriculture, Coimbatore informed that the Department of Agriculture, Tamil Nadu, is coordinating activities of various line departments in the State. The Department is recommending only the varieties released by TNAU. It was pointed out that some of the private sector varieties are doing better and the SAUs / Institutes have to take cognizance of the fact.

Participating in the discussion, Dr. Narayana Gowda, Vice Chancellor, University of Agricultural Sciences, Bangalore said that agriculture is facing serious crisis on account of low

profitability. This is a serious concern and integrated farming approaches are recommended to make agriculture more profitable and viable. In Karnataka, farmers association has been formed and training is imparted to them on market intelligence and other customized services. The serious nature of Areca Yellow Leaf Disease (YLD) which is affecting the areca plantations in the State was mentioned. Dr. G.V. Thomas, Director, CPCRI responded that the Areca YLD is caused by phytoplasma and an integrated package is available for enhancing / sustaining the yields of affected palms. Besides, resistant palms are also now available. It is also important to look into the soil factors in relation to the disease. To a query on the report of embryo-culture technology developed by Mexico, Dr. Thomas replied that the technology is not new and CPCRI is already working on embryo-culture technology. However, the rate of multiplication is low at present. The forum felt that apart from the planting material, there should be emphasis on deriving management solutions to take care of the affected plantations. University of Agricultural Sciences, Bangalore has also done extensive work on management of Areca YLD and that there is already a package evolved. The Chairman suggested that this may be evaluated at a few locations. The Chairman suggested formation of a Committee to look into the issues of Coconut wilt and Arecanut YLD which will prepare a Status Report on the two diseases. Dr. G.V. Thomas will be the coordinator for this Committee.

The Chairman queried about the drought situation in Karnataka. It was informed that 123 Taluks had been affected by drought due to delay in the onset of monsoon. Drought mitigation strategies are to be worked out and the Chairman suggested in this context that short duration varieties of crops have to be considered. It was informed that some of the hybrid rice developed by UAS, Bangalore is likely to make impact on rice productivity in the State.

The situation with respect to productivity and the production of minor millets is not encouraging in Karnataka. Area, productivity and production are coming down in the state. These crops have a great future in the context of high nutritional value and also their ability to withstand climate change. There is a need for further research on all aspects of minor millets production and value addition. It was also felt that there is an urgent need to enhance seed production in minor millets and greater need to popularize their use. In fox tail millet and finger millet, very good varieties have been developed and more than 25% yield improvement could be achieved. But in many other minor millets, this is not the case. To a query from the Chairman, it was informed that a sizeable collection of minor millets is available in TNAU gene bank. It was suggested that the Gene Bank information held by TNAU may be made available so that the material could be shared by the SAUs / Institutes. UAS, Dharwad is promoting the cultivation of minor millets in a big way with emphasis on characterisation, value addition and large scale seed production. It was suggested that the AICRP Centre at UAS, Dharwad may be upgraded to a regular centre. It was stressed that minor millets need more attention in view of their hardiness, higher nutritional value and better adaptation to climate change. Mechanization becomes necessary in view of the prevailing labour situation. What are needed are machineries which can do multiple operations across crops.

To a query, it was informed that salinity and alkalinity are major problems in North Karnataka. UAS, Dharwad, has taken up reclamation efforts through its RKVY programme. Water use associations have been formed to impart training on how to use the available water judiciously.

The issue of rust in soybean, a major crop in North Karnataka and sunflower was flagged by UAS, Dharwad. Maize area is expanding, but research efforts are limited because of lack of resources. The Chairman informed that RKVY funds could be channelized to equip the centres to address these issues. The Chairman also suggested that the agencies should set a target of 10 lakh tonnes of pigeon pea and chick pea for the region.

Dr. Sadamate, Advisor (Agriculture), Planning Commission, felt that there should be a relook into the strategy for cotton. The issue is whether the hybrid cotton can be sustained in view of the popularity of Bt cotton. The Chairman enquired about colour cotton and how contract farming could be of use in enhancing the cultivation of colour cotton for which there is a huge demand. The problem with growing colour cotton is contamination with conventional white cotton apart from techno economic feasibility of colour cotton. Shri Bhargava, GB member, ICAR society, felt that the public sector should have been more proactive in the case of transgenic research. The Bt gene could have been purchased from Monsanto and incorporated into our hybrids and could have been profitably deployed along with private Bt hybrids. This could have avoided the current domination of the private sector in 'Bt cotton'. Dr. Sadamate suggested to frame soil maps for every state to see what crops could be best suited for the respective soils.

Looking at the fodder situation in Karnataka, it was informed that UAS, Dharwad has been producing significant quantities of fodder seed / planting material. IGFR has released suitable fodder varieties for all three southern States. It was felt that the required quantities of planting material of fodder can be produced only in a decentralized way through KVKs and Regional Stations of SAUs. Dr. Prasad, Director, NIANP felt that the responsibility for fodder production essentially rests with the State Departments. ICAR & SAUs could provide technological backstopping by way of varieties, package of practices, enrichment techniques and conservation methods. The fodder production villages in Punjab and Haryana were cited as good examples for sustainable fodder production and similar models were suggested for the southern states. During the discussion, it emerged that most of the KVKs in southern States are actively engaged in fodder production. KVK, Namakkal has been doing excellent work in fodder production. The Cumbu Napier hybrid Co 4 developed by TNAU is very popular and can yield 450 t of green matter yield/year, and is now grown in more than 40,000 ha. With the introduction of combined harvester, significant quantity of hay is wasted during harvesting of paddy. It was pointed out that there are efficient machineries that will avoid wastage of straw during harvesting. The effectiveness of these machineries needs to be demonstrated. There was also a suggestion that whenever a variety is released, not only grain quality but straw quality also has to be considered. The need for Fodder Seed Risk Fund was raised during the discussion. The demand for fodder seed is not consistent and in some years, the demand will be far less than production. Under the circumstances, the Fodder Seed Risk Fund becomes inevitable to pre-empt any loss to the fodder seed production units. In this context, establishment of Community Fodder Bank also was suggested to be considered as a strategy to meet the fodder shortage.

IIHR has released several varieties and hybrids of horticultural crops and also developed several other technologies. It was pointed out that the Institute is selling its technologies. If the technologies are given free to SAUs, the varieties and products will become more popular. Shri Bhargava commenting on the seed pricing system with respect to hybrids and varieties said that the situation is vastly changed now and the farmers are prepared to pay higher seed price provided they will get higher yield and thereby higher income. Dr. Prasad, felt that enough attention is to be paid in establishing fodder banks. Dr. Naik expressed concern that plant protection chemicals are not got approved through Central Insecticide Board before they are included in the package of practices by different Universities.

Dr. Dandin, Vice Chancellor, University of Horticultural Sciences, Bagalkot, informed that the university has significantly improved the production of the planting materials. The grape production during the year was good, but there were problems with regard to processing. Onion farmers suffered losses because of lack of adequate storage facilities. During the discussion it was suggested that low dose irradiation may help in arresting sprouting in onion and extending its shelf life. The university is collaborating with CTCRI in value addition of sweet potato. It was also informed that climate change has affected mango production in the state. The flowering

time and fruiting pattern has been affected and there is a need for some basic studies on the reproductive biology of mango.

Dr. Patil, Vice Chancellor, UAS, Raichur outlined the progress made by the University in Agriculture, Education and related fields. One of the important initiatives of the University was training of engineering students to start their own service centres. Entrepreneur development in areas like production of Biofertilizers, bio-pesticides etc. also is being organized by the University. Seed production has been strengthened in major crops including Paddy. The University is also promoting integrated farming system. As for mechanization, small machines suitable for smaller holdings are being developed. A multi thresher has been developed using a cycle which is becoming popular in the region and could be used for bajra, sorghum etc. The Chairman suggested that the equipments developed by ICAR and SAUs may be tested and categorized and circulated among all KVKs. To a query from the Chairman, Dr. Patil informed that 48% of area under the University's jurisdiction is irrigated. The Chairman expressed concern over the lack of spread of drip irrigation in Karnataka inspite of the Government subsidies. He mentioned that under XII Plan, due priority would be given for (1) Energy through renewable sources, (2) Water conservation and (3) Waste management. UAS, Raichur has successfully implemented transplanting of red grams, which give improved yields with reduced seed requirement. Shri Bhargava suggested that this technology may be given wide publicity so that more people will adopt this technology.

Dr. Honnappagol, Vice Chancellor, KVAFSU outlined the progress of Research, Education and Extension activities at KVAFSU, Bidar. A new Institute for wild life veterinary medicine has been started by the University in Coorg and M. V. Sc. course in wild life medicine is being now offered by the University. Four poultry hatching units have been established in four places in Bangalore, Bidar, Hassan and Shimoga to make available day old chicks to farmers. Efforts are being made for conservation of Deoni breed of cattle with the support of Cattle Farmers Association. An animal ambulance fleet has been created to provide treatment to ailing animals at the doorstep of the farmers. A Fishery Research and Information Centre has been established in Bijapur district. A Canine Research and Information Centre to take up studies on Mudhol breed of dogs also has been initiated. In the fishery sector, considerable progress has been achieved in indigenous ornamental fish culture. Forty species of ornamental fishes have been identified from the Western Ghats, out of which, 16 species have been bred and are ready for commercialization. A Rapidot diagnostic kit has been developed for white spot disease and the same has been successfully demonstrated in Sri Lanka also. The University has developed a package for paddy cum fish culture along the coastal areas. During the interaction, the potential of cashew apple as a nutritious source for cattle feed was discussed. However, it was felt that further research is needed in this area because of its high tannin content. NBFGR Centre, Kochi informed that they have recorded 347 species of fish in the region, out of which 110 are of ornamental value.

Referring to the agricultural situation in Kerala State, the Chairman expressed concern on the declining trend in Agriculture in the State. Dr. Gopalakrishnan, Director of Research, KAU informed the House that the most serious issue in Kerala is the acute shortage and high cost of labour. The cost of production is very high in the state, with the result the paddy area has come down significantly. KAU has conceptualized and launched a Food Security Army to develop trained labour force to address the issue to labour shortage. About 400 people have been given intensive training on operation and maintenance of farm machineries. The paddy area in the State has come down over the years whereas area under some of the crops like banana has increased because of its remunerative nature. The Chairman enquired about the land use plan for the State. It was informed that LUP is mainly based on multi tier cropping system including coconut, pepper, pine apple, tuber crops etc. It was informed that the State Government has banned all red and yellow label chemicals, pesticides and weedicides and in this context, the University is developing organic farming packages. During the last two years, the University has

developed 14 varieties including 7 varieties of paddy. Two of the paddy varieties are saline tolerant and two are drought tolerant. University has realized 6.25 crores from sales of planting material during the last year. Vegetable and fruit promotion council with 120,000 farmers in its fold is providing support to farmers by way of intensive training, credit support, insurance support and market support. In the mechanization front, the University had been addressing location specific problems. A coconut dehusking machine has been developed which is very popular. Similarly, the University has developed a coconut climber which is also in great demand. The University has also developed a prototype machine for harvesting pokkali paddy under submerged condition. Rs. 45 crores have been allotted by the State Government for precision farming and the University has standardized an ideal model for precision farming in the State and this is being scaled up. Dr. Gopalakrishnan also informed that in Kerala 90% of vegetable varieties under cultivation are from the University. In the academic front, the University has been performing well and won the performance award for the Best Agricultural University for the last 6 years consecutively. The University has also won maximum JRF/SRF positions during the last two years. KAU has started integrated courses on Biotechnology, climate adaptation etc. The University has introduced the concept of Agricultural Cadet Corps in the lines of NCC with the objective of building confidence, professional ethics and values in the agricultural sector, which has been nationally acclaimed.

In the Animal Husbandry sector, the total animal population is coming down in Kerala. Another concern is the paucity of feed since the scope for fodder production in the state is limited in view of the limited land availability. High cost and non availability of labour is also affecting growth of the Animal Husbandry sector. The Kerala Veterinary and Animal Science University has done mineral mapping and identified areas showing mineral deficiency and corrective action has been taken. Efforts are being made to conserve endemic breeds like Kasaragod dwarf, Kuttanad buffaloes, Tellicherry chicken etc. There is a deficit of 30 – 40% in milk and milk products, egg and meat on an average in the State. The Idukki and Wynad districts could be milk bowls of the state in view of the high cross bred population available and the awareness on the management of these cross breeds. During the discussion, it was mentioned that two major problems in cattle in the State are the low SNF and infertility. Efforts are being made to address this issue through the AICRP programme by developing package of practices to lower blood urea and nitrogen and also develop nutrient formulations for countering riboflavin deficiency. The University has also evolved an effective waste disposal system through aerobic composting technique.

The Kerala University of Fisheries and Ocean Studies is of recent origin and has started functioning from April 2011. Apart from ongoing undergraduate programme the University is planning to start 5 new PG programmes including 3 in ocean studies. Under the Matsya Samrudhi programme of Kerala Government, the fish production is to be increased to 2.5 Lakh tonnes from the current 1.5 lakh tonnes in next 3 years. A Seed Bank for ornamental fish and aquaculture of important fishes is being established by the University. The University has identified more than 100 species of fishes from the Western Ghats which have potential as ornamental fish. The university is focusing on the conservation of the fish genetic resources of the Western Ghats, particularly with respect to those classified as endangered species. The University is also focusing on aquaculture in relation to Pokkali cultivation.

The need for integration of R&D activities and regular interaction of R&D organizations in the States was felt for the overall development of the State / region. The Chairman suggested that each ICAR Institute should have two or three flagship programmes in the XII Plan. It was also suggested that there should be a coordination mechanism among the SAUs, ICAR Institutes and the line departments in the states to address the specific issues of each state. The Chairman also felt that there should not be any contradiction in the recommendations of varieties and package of practices by ICAR Institutes and SAUs.

The Director of Research, TNAU briefed the forum on the research progress made by the University in various fields. The papaya mealy bug which was a serious problem on Papaya, Cotton, mulberry and cassava had been managed through the deployment of the parasitoid *Acerophagus papayae*, which was a major success. Some of the TNAU varieties like Cumbu Napier Co 4 are performing well providing very high yield to the farmers. The major problem for the University is the seed production. Many of the new varieties released in the past could not reach the farmers because of inadequate seed production. The State needs 34,000 mt of seed to cover the seed supply chain in the entire state. The University is producing hardly 3000 quintals of breeder seed. The forum felt the need for moderating the breeder seed production. On one hand the seed production is reported to be insufficient while there are many instances where the seed produced is not lifted by the indenting organizations resulting in losses to the seed producing agencies.

Coming to the academic front, TNAU has introduced new M. Tech. courses in Nanotechnology, Geoinformatics, MBA course in Forestry and M.Sc. in Plant Genetic Resources recently. The Chairman concurred that TNAU has started several innovative courses. He felt that the SAUs should start diploma courses in skill development. He also suggested exploiting the distance learning and non-formal learning options for skill development in agriculture and related sectors. There was a discussion on opening of the private agricultural colleges. It was felt that private agricultural colleges need to be affiliated to the Agricultural Universities to ensure quality education. The Director of Extension Education, TNAU explained the extension activities taken up by the University. Through KVKs several technologies have been demonstrated and validated. Besides, KVK support was also utilized in standardizing many technologies specific to specific areas. The technologies demonstrated are now being scaled up with the support of various agencies.

Two veterinary colleges have been started by TANUVAS in the previous year. A new Institute for poultry production and management is being established by TANUVAS. A new undergraduate course on B. Tech. in poultry production also has been started. The University is also starting a P.G. Diploma in regenerative medicine and another one in ethno-botanical medicine. TANUVAS has developed smart Mineral Mixture for different parts of the State and the technology has been transferred to milk producing agencies like Aavin. The University has also made significant contribution in addressing issues like estrus synchronization. There was discussion on emu farming, which is being promoted as a high return farming system in the state, which is not true. The infertility problem in Buffalo and the declining population of Buffalo are two major issues in the state. New diseases like the infectious bronchitis in Namakkal area in poultry and infectious laryngo tracheitis and the low pathogen avian influenza are emerging. TANUVAS is conducting orientation programmes for the newly recruited veterinarians to upgrade their skills. The States are facing problems on the farming of Japanese quails because of the interference from the forest department.

There was a suggestion that animal scientists should be posted in all KVKs. There is perceptible growth in animal husbandry since cropping area is getting reduced due to climate change, labor shortage and other issues and more and more people are moving over to animal husbandry. In this context, posting of an Animal Scientist at KVKs is important for providing adequate technical support to the people. The problem of mastitis in cattle is common in the state and the causal organism *Staphylococcus* is very difficult to eradicate and often does not respond to treatment. The University recommends antibiotic treatment wherever mastitis occur. A proper diagnostic system using a magnetic assay is being developed to identify the bacteria and its sensitivity to the antibiotics so that precise treatment could be adopted. To a query from the Chair on FMD instances in the State, it was informed that FMD is a serious problem and now the University is advocating two times vaccination. The pesticide and antibody residue in egg is a serious issue affecting export of egg from the state and a facility for monitoring residues has been established. TANUVAS has developed vaccines against major animal diseases, but there had

been problems in validating the vaccines. TANUVAS requires a large experimental facility for validating the vaccines.

The Chairman sought the response of the ICAR officials, directors and other functionaries on the issues raised by the state departments and the Universities. Dr. K. C. Bansal, Director, NBPGR said that in the previous meeting a recommendation was made that the germplasm collected by the SAUs should be accessioned with NBPGR. But only few SAUs have complied with this recommendation. NBPGR is developing an Agro-biodiversity platform networking ICAR Institutes and SAUs for collection, characterization and conservation of agro-biodiversity in the Country. The services of KVKs particularly those in the North East region could be enlisted for germplasm collection from the remote locations in Northeast India. For characterization and evaluation, the support of the SAUs is very essential. Germplasm available with NBPGR can be shared with all SAUs and Institutes. The emphasis should be on identifying trait specific germplasm for utilization in breeding. The medium term storage facility available at different centres of NBPGR at Thrissur and Hyderabad may be used for medium term storage of germplasm by the SAUs and Institutes. Dr. Kulkarni, UAS, Dharwad felt that there is considerable scope for germplasm collection in this region particularly from the Western Ghats. It was suggested that there is a need for obtaining dicoccum wheat germplasm from CIMMYT, Mexico for strengthening the dicoccum breeding programme, particularly in Karnataka.

To a query from the Chair, Dr. James George, Project Coordinator, Tuber Crops informed that the area under tuber crops is on the decline. However, the productivity has increased and Tamil Nadu has the world record of 45 t/ha. There is a possibility of more area coming under cassava cultivation in nontraditional areas like Maharashtra and Punjab in coming years. The possibility of using sweet potato for dual purpose for consumption and fodder was discussed. In the region, potato cultivation is largely confined to Nilgiris where 4500 ha are under the crop. The nematode resistant varieties like K.Swarna, K. Jyoti, K. Giriraj, and K. Himalini are high yielding varieties recommended for Nilgiris. Nematode continues to be a major problem in potato crop in the hills. The new variety Kufri Neelima, resistant to cyst nematode and late blight is ready for distribution. There had been a problem of seed produced by the Centre being not lifted by the line departments. However, from 2011 onwards, the Horticulture department is purchasing the entire quantity of seed produced by the centre. In Kerala nearly 3000 acres in Idukki district is growing potato. The area is facing severe problem of late blight and requested for technical support from CPRI Regional Station.

Dr. Prabhukumar, Zonal Project Director mentioned that 80 KVKs are functioning in the region. KVKs are taking part in validating package of practices and other technologies. Regarding seed production, KVKs could also participate in the seed production of hybrids if the parental lines are provided. A suggestion was made that the Lakshadweep KVK may be transferred to CPCRI centre Minicoy. It was pointed out that the KVK staff are performing different types of duties and hence a separate score card may be developed for the promotion of KVK staff. The issue of frequent transfer of KVK staff particularly Programme Coordinators was discussed and it was suggested that the transfer of KVK staff to be kept to minimum. It was also recommended that SAUs and ICAR Institutes should provide the latest technology to KVKs for assessment, refinement and demonstration. It was emphasized that the income generated from Revolving Fund should be given to KVKs for infrastructure development and should not be diverted. Difficulty was expressed in getting Veterinary graduates as SMS in KVKs. Some of the Universities are paying non practicing allowance to veterinary doctors which attract more people to join KVKs. Regarding the request from Fisheries and Veterinary Universities of Kerala for KVKs, it was informed that new KVKs could be established only when new districts are formed.

The Director, NBAII mentioned about the possible invasion of the pest *Brandispa* which is likely to enter our country which could be a serious threat to Coconut cultivation. Coming to the management of pest in tea plantations, it was informed that NBAII is ready to cooperate with

UPASI in mapping the biodiversity of parasitoids and predators. It was also suggested that KVKs could take up the production of quality biopesticides which could help in the management of important pests. There is also a need to examine the package of practices for plant protection across the States where there are uniform or different parasitoids. The Chairman suggested that there is a need for continuous monitoring to locate effective parasitoids particularly in the context of new pests emerging across crops. The Chairman asked the Scientists from SAUs and Institutes to estimate the savings made through the deployment of parasitoids for the control of papaya mealy bug stressing that it is necessary to project major achievements in research in its right perspective. There was discussion on the need to register bio-pesticides and other bio-formulations with the Central Insecticide Board and the forum felt they need to be registered by the SAUs and the Institutes concerned.

Dr. S.A. Faruqui, Director, IGFR gave the overview of fodder research in the region. IGFR has a regional centre at Dharwad catering to the needs of the region which also works in close coordination with the SAUs. A number of new fodder varieties have been developed. TNAU has identified TNCN 074 and Mandya centre of UAS, has developed 48 MST0814 which have been released for cultivation. IGFR is giving emphasis on dual purpose varieties for fodder and grains and suitable cropping systems for such varieties are being developed. The Dharwad centre had been working on fodder crops suited for the region including Napier and Guinea grass, Lucerne and an ideal combination is being worked out. It was mentioned that under dry land farming, the animal component improves the livelihood options of the farming community. Hence there is a need for fodder research under dry land situation.

Dr. Prasad, Director, NIANP stressed the need for creation of quality database on the district wise availability of green fodder. He mentioned that NIANP has developed a technology for the use of areca sheath for making feed blocks which is becoming very popular in Shimoga district, in view of the high cost of paddy straw. A prototype machine for chopping the areca sheath is being developed with CIAE collaboration. The mineral maps of most of the States except Andaman and Nicobar and Jammu & Kashmir are currently available based on which the feeding of animals have been optimized. Referring to the embryonic mortality in Buffalo, it was informed that the oxidatory stress could be reduced by modifying the diet. The potential of hydroponics in supplementing fodder was discussed. The Azolla cultivation has picked up in Karnataka and Tamil Nadu. Azolla gives 21% of protein and could be used as a supplement to the green fodder. At present there is no agency to address the issue of feed quality and safety. This is becoming increasingly important in view of the high antibiotic and pesticide residue presence in feed and fodder.

The marine fish production has shown marginal increase over the years. CMFRI has used satellite tracking for important species and had been successful in tracking the movement of yellow fin tuna. The Institute has also come out with recommendations for optimum fleet sizes for the maritime states. However, the implementation of the recommendations had not been successful in view of the poor response from the state departments. CMFRI also had been actively engaged in biodiversity conservation, coral preservation and mangrove restoration. Two new marine products for human consumption, viz., green mussel extract and green Algae extract had been developed and are ready for commercialization. CMFRI has also successfully cultured the black pearl from Andaman & Nicobar islands for the first time. The Mandapam centre of CMFRI has successfully developed brood stock and seed production in Cobia and Pompano and the technology has been demonstrated in Kerala and Tamil Nadu.

The Fisheries Department of Tamil Nadu informed that the department is installing artificial reefs for stock enhancement in 5 coastal districts. The department has also started conversion of mechanized fishing boats to Tuna long liners with a subsidy of Rs. 5 lakhs per boat. The department also has a plan to launch mother vessels which could carry 8 - 10 baby vessels to facilitate mid sea fishing. The mother vessels could go to the mid sea carrying 8 – 10 baby vessels

which could fish in the mid sea and the deep sea. The department also has plans to stock trout in Nilgiris waters.

Dr. Ponnaiah, Director, CIBA addressed the disease problems in brackish water fish culture and said that sensitizing the farmers is of utmost importance. CIBA has perfected the technique for nursery rearing of crabs. Disease problems following the introduction of new species are a cause of concern and CIBA has been conducting awareness programmes among farmers and state fisheries officials on this issue. A network project is planned on aquatic health which will address all diseases issues. Addressing some of the food safety concerns because of the excessive use of antibiotics, the Fisheries Colleges had already been contacted and given the necessary input in monitoring the antibiotic residues present in fish and fish products. CIBA is also looking at the pokkali fish culture in Kerala wherein the productivity is reported to be coming down. The Chairman mentioned that there is lot of scope for fresh water aquaculture in northern Karnataka. The technologies developed by CIBA and its Centres need to be passed on to the Universities and KVKs for adoption. The major issue with regard to fish genetic resources in the region is conservation and management of regional species of importance which has to be done on a collaborative mode. The seed production in regional species is also has a serious issue which needs to be addressed. The major technologies developed by CIFT were elaborated by Dr. Srinivasa Gopal, Director, CIFT. The solar dryer developed by CIFT is now being considered for use in turmeric drying. The effluent treatment plants developed by the Institute are useful for any food processing industry irrespective of the source material used. One of the major issues in fisheries today is responsible fishing for which the state governments have to be more proactive. The post-harvest losses are considerable in view of the inadequate support of processing facilities. The waste management also is a major issue. The labour costs in the states have gone up significantly high and there is a need for developing mechanical peelers. The Chairman suggested that attention should be paid to the fishery sector of Lakshadweep. Marine fisheries management and post-harvest technology for Lakshadweep should be taken as an action point by the Institutes concerned. The Chairman also suggested that CMFRI and CIFT should focus on improving Tuna export from the islands.

PDADMAS has 15 centres working in the country on monitoring and surveillance of animal diseases. Referring to the region, Dr. Rahman, Director, PD ADMAS, said that information on animal diseases is received from Karnataka and Kerala but not from Tamil Nadu. There is need for an AICRP Centre in Tamil Nadu in this context. The Chairman suggested that PDADMAS should advice the State Governments on the likely occurrence of diseases and on their management including frequency of vaccination, dosage and the monitoring aspects. Dr. Venkataraman, JD, IVRI Regional Centre, Bangalore informed that there is a major control programme in the region for three important diseases like FMD, PPR and Brucellosis. The support and active participation of the development department is absolutely necessary to make the programme successful. To a query from Chairman, it was informed that there is no FMD in Lakshadweep. Dr. Venkataraman cautioned that the diseases like HPI should be dealt by high security animal disease laboratory only and the Universities should keep away from this disease in view of security concerns. It was suggested that FMD vaccination has to be done on a campaign basis with the support of all line departments, SAUs, Institutes and KVKs.

NDRI Regional Centre, Bangalore has developed 23 different dairy products and provides technical support and training in their production. In the dairy sector, acute manpower shortage exists and there is a need for re-organizing the dairy diploma programmes. As per the AICTE rules, the dairy diploma has to be on par with other programmes of AICTE which are of three years duration and will also provide an opportunity to the diploma holders for joining B. Sc. in Dairy Technology.

Dr. Sidhu, Director, IIHR said that there is increase in the production of fruits and vegetables from the 3 states. In Tamil Nadu, particularly the productivity of vegetables and fruits

is high. Drip irrigation could be one factor contributing to high productivity. IIHR has several technologies for horticulture crops including varieties, hybrids, production management and post-harvest management and the technologies are available for all the SAUs and KVKs.

Tamil Nadu stands first followed by Kerala and Karnataka in Coconut productivity. The low productivity in Kerala and Karnataka is mainly due to high cost of labour and low adoption of technology. In Tamil Nadu, root wilt disease is spreading in 3 districts viz., Theni, Tirunelveli (Shengottai) and Kanyakumari. It is necessary to slow down the spread of disease by developing a border belt as has been done in Kerala followed by removal of diseased palms. Areca YLD is a serious problem in Kerala and Karnataka and integrated practices are now available to improve productivity of the affected palms. CPCRI has developed virgin coconut oil production technology which gives better sale value for coconut oil and the technology has been passed on to commercial firms. Integrated management technology is available for oil palm and the farmers are adapting the technology increasingly. New hybrids NRCOP1-10 and 11-14 developed by NRC Oil Palm are performing well.

There had been significant increase in area under cotton in Karnataka. The production also has increased mainly due to the introduction of Bt hybrids. However some of the minor pests have become major pests following the introduction of Bt cotton.

The CIAE centre at Coimbatore is promoting mechanization in many crops. Paddy transplanter is becoming popular and the centre is conducting training for farmers in raising mat type nurseries. The centre has developed bud chipping machines and a seedling transplanter for sugarcane in collaboration with Sugarcane Breeding Institute. The Chairman suggested that the Centre needs to be strengthened in terms of manpower and infrastructure.

CSWRI, Mannavanur maintains and distributes rabbit breeds. There are over 500 rabbit farms in Tamil Nadu. The sheep and rabbit wool produced are of export quality and is being used by the local knitting industry for making quality knitwear.

Dr Jonathan, Director, Centre for Plant Protection Studies, TNAU made a presentation on the control of mealy bugs in the state by deploying the parasitoid *Acerorhagus papayae*. In all, 36 research stations, 7 colleges and 14 KVKs were involved in the mass production and distribution of the parasitoids and training of personnel. It was suggested that the economic impact of this technology may be worked out. The University is also developing other biocontrol agents like *Beauveria* and *Pseudomonas*.

Dr Umesh Srivastava observed that there had been substantial increase in the production of fruits and vegetables in both Tamil Nadu and Karnataka. The tuber crops varieties developed by the CTCRI are high yielding and good in quality. The mosaic resistant cassava variety CMR-1 identified through farmers participatory programme is becoming popular in Tamil Nadu. The banana production in Tamil Nadu has gone up from 4.5 t/ha to 5.6 t/ha. The overall scenario in horticultural crops is encouraging. Cashew is an important crop in the region and put together nearly 4.0 lakh ha area is under cashew cultivation in the three states. DCR, Puthur has developed high yielding varieties and they also produce planting material of the new varieties in large scale. The Thane cyclone has done extensive damage to cashew plantations in Cuddalore area in Tamil Nadu and has uprooted trees in over 20000 acres. The production of planting material was increased to meet the demand for replanting in affected areas.

Dr. Gupta, ADG, Animal Science informed that the cattle improvement programme in the region has been taken up under the network/AICRP/outreach projects. Efforts are on to conserve and improve the traditional breeds like the Toda buffalo of Nilgiris and the Umbalacherry cattle of Tanjore. Toda buffalo is an endangered breed and the population is below 5000. There is about 43% crossbred cattle in the region. There are 1.8 million crossbreds in Tamil Nadu, 0.7 million in Kerala and 0.9 million in Karnataka. The production level in the

region is low compared to Punjab and Haryana and there is a need to improve the crossbred population in the region. There is much diversity in sheep in the region as 12 breeds, out of which 8 are in Tamil Nadu. There is much scope for rabbit farming in the region as demand for rabbit meat is on the increase particularly in Kerala.

Emu farming was introduced in Tamil Nadu without much research. Some studies on Emu are being carried out at two centres of TANUVAS at Pudukkottai and at Chennai, it was informed. The Chairman suggested that a small scale study may be initiated on Emu farming and on value addition on its products.

It was reported that estrus synchronization protocols have been developed by TANUVAS. CSWRI Avikanagar also has developed a sponge technique for goat and sheep which has been found to be very successful and cost effective. This technique also had been validated on buffalos. The two techniques can be compared for cost effectiveness and efficiency.

Dr Gopalakrishnan, ADG (CC), ICAR outlined the efforts of the Crop Science Division in strengthening the research activities through both conventional and biotechnological approaches for improving productivity. It was mentioned that the DNA fingerprinting data are not forthcoming from the breeders at the time of release of the varieties by the Central Varietal Release Committee. There is considerable delay in centrally released sorghum varieties reaching the farmers particularly in Karnataka, pending state level testing. It was suggested that the centrally released varieties should be straightaway adopted for cultivation in states as they have already undergone multi-location testing in the states under the AICRP. Concern was expressed on the frequent transfer of staff in the AICRPs which affect the effective execution of AICRP programmes. Transgenic research is going on in various crops in the SAUs and Institutes and the trials are to be conducted after obtaining the NOC from the state governments even after GEAC approval.

Dr Mustafa, Director, NRCB, informed that the banana area in Tamil Nadu is expanding and the state ranks first in productivity. The crop is raised in Kerala under rainfed conditions mostly in Home gardens and the yields are low. NRCB has developed a technology for optimum plant population with fertigation for increasing productivity. The centre has also developed tissue culture techniques to produce 30 - 40 plantlets in 3 - 4 months. In general there is a shortage of planting material as the commercial tissue culture units are interested only in Robusta and Grand Naine varieties and not in the traditional varieties. The major issues concerning Cashew in the region are pests and low productivity. Productivity is the lowest in Kerala due to declining soil health. Unlike Brazil and Vietnam, we do not have dwarf compact types suitable for high density planting. The major pest namely Tea mosquito can be managed through *Beauveria bassiana*. There had been substantial damage to cashew plantations in Cuddalore district in Tamil Nadu due to Cyclone Thane and production of planting material has been stepped up for taking up replanting of the affected plantations.

The production of spices in the region is 6.74 lakh tonnes and KAU has developed pepper varieties which are disease resistant and high yielding. Non availability of planting material is again a serious concern in cardamom, pepper and ginger. There is also acute shortage of labour for field operations, and mechanization of planting, harvesting and post-harvest processing of ginger and turmeric is being taken up by IISR, Calicut. The solar cooker and dryer developed by CIFT have been found useful for drying ginger and turmeric. It was pointed out that farmers in North Karnataka are suffering losses due to shortage of processing units. The chairman suggested that entrepreneur development and custom hiring of processing machines should be explored. The Director, IISR felt the need for importing disease resistant pepper lines and germplasm from Madagascar and Brazil. Thrips is a major problem in cardamom and there appear to be a lack of coordination among the research centres in evolving suitable management

strategies against this pest. It was suggested that the centres at Appangala, Sakleshpur and Mayiladumpara should jointly develop packages for cardamom.

Cassava production in the region is increasing despite the decline in area. This is due to the improved productivity, which is among the highest in the world. The consumption of cassava has declined and value addition has become essential for sustaining the crop. Cassava mosaic is a serious issue and there is a need to strengthen healthy seed production in Cassava. Sugarcane is an important crop in the region and Karnataka and Tamil Nadu ranks third and fourth in terms of sugarcane production. The major issues in the crop are the high cost of cultivation due to escalating cost of inputs and labour. Mechanization of cultural operations and harvest is taking place in Tamil Nadu and to some extent in Karnataka. There is an absolute need to develop smaller harvesting machines since the heavy machineries currently available are not suitable for small holdings. Sugarcane productivity in the region has remained static for the past two decades which is again a cause of concern. A single variety Co 86032 is dominating the varietal scene occupying over 90% area in Tamil Nadu and over 50% area in Karnataka. Varietal decline is the main cause for static productivity and there is a need for effective seed programme and replacement of older varieties. Yellow Leaf Disease is rampant in the region which is affecting the yield to a significant level. Since the existing varieties are susceptible to YLD, only healthy seed programme based on tissue culture nurseries can sustain the productivity. However the capacity for the production of tissue culture plants in required quantities is limited at present. Drip irrigation and residue recycling is being promoted by different agencies to conserve natural resources and to improve soil health. To a query on the varieties for jaggery, Dr. Nair, informed that the variety Co 92005 developed by SBI has been released for cultivation in Maharashtra and gives excellent quality of jaggery. As for value addition, SBI has developed technologies for sugarcane juice preservation and the process of spray drying sugarcane juice has been commercialized.

Cotton cultivation has increased in area in both Tamil Nadu and Karnataka. The cotton production has also increased following the introduction of Bt cotton. However there was no significant increase in productivity since the introduction of Bt cotton in 2005 to the present. Of late there had been increase in the pest load, particularly of some of the minor and earlier unknown pests. There is a perceptible increase in sucking pests in cotton, which could be controlled by seed treatment with Imidacloprid. Mealy bug is also a major problem. To a query from the chair, it was informed that efforts are on to develop interspecific hybrids of cotton at CICR regional station, Coimbatore and many are in the pipeline. The IARI Regional Station Wellington has developed wheat varieties suited for the plains of Tamil Nadu. The Centre is also developing dicoccum wheat suited for Southern states. The Regional Centre of the Central Soil and Water conservation Research and Training Institute, Ooty is conducting soil and water conservation studies and watershed management in the region. Integrated farming system for small and marginal farmers is being implemented by the centre. Increasing wastelands, widespread nutrient deficiency, salinity, sodicity, over exploitation of ground water etc. are the major land resource issues affecting the region. The Bangalore centre of NBSSLUP is addressing these issues through various projects. A project has been developed by the centre to address these issues through mapping of soil and land resources, identifying resource threats, soil reclamation strategies and evolving situation specific cropping systems networking various stake holders and line departments.

The mechanization in paddy cultivation is satisfactory with respect to Kerala, Tamil Nadu and Karnataka states. The CIAE centre, Coimbatore has been working in close coordination with small equipment manufacturers in producing quality products for promoting mechanization in the region. The Centre has developed a number of implements which are now being manufactured by the local industry. In collaboration with Sugarcane Breeding Institute, the centre has developed a pedal operated bud chipping machine, a pneumatic bud chipping

machine and a transplanter to transplant bud chip seedlings. The Chairman suggested that the Centre needs strengthening in terms of man power and infrastructure.

Dr M.M. Pandey, DDG, Engineering, informed that farm labour is a serious constraint in the region. Efforts are on to develop and validate machineries and implements suited for various farm operations through the 11 AICRP centres in the region. There is an emergent need for development of renewable energy based technologies particularly Solar Photovoltaic system for various energy needs including lighting and drying of agri-horti produces. The labour situation in Kerala is more acute and the progress made by the state in mechanization of paddy cultivation including field preparation, transplanting and harvesting through entrepreneurship models is commendable. Tamil Nadu has a very good manufacturing network with which TNAU and CIAE centres are collaborating. As for sugarcane harvester, M/S John Deere is developing models suitable for our conditions.

Dr. Meenakumari, DDG, Fisheries, dealt on waste management, use of non-conventional energy sources and mechanization in the fishery sector. The effluent treatment plant developed by CIFT is widely appreciated. CIFT has also developed a technology for the management of squid waste, which is now converted to either fish feed or poultry feed. Similarly silage from Tuna heads are being used as feed for cage reared fish. The power block developed by CIFT has been widely accepted as it reduces the labour in small scale sea fishing. Major issues in fisheries are quality feed, seed and interventions in disease. CMFRI has bred Cobia and Pompano and the Pompano seed had been provided to farmers in Andhra Pradesh. Quick fishing and Tuna long lining has been introduced to the Lakshadweep as part of Island development. The real problem for the islanders is marketing the catch since they consume only Tuna. Under NAIP, seven boats have been converted to Tuna long liners for Agathi, Androth and Minicoy islands. Under the MPEDA scheme, nearly 100 boats have been converted to tuna long liners. The optimum fleet size for the region has been worked out by CMFRI, but the implementation rests with the respective state governments. There had been a visible shift in the labour profile in the fishery sector in the region. As there is acute shortage of local labour in the region, it is the labour from Bihar or Bengal who are currently being engaged in the fishing industry. Even in the processing sector, till now a domain of women labour from Kerala, this shift is visible.

Dr. Bangali Baboo, ND, NAIP said that there are 37 lead projects and 128 associate projects being operated in the region under NAIP. There are several success stories from the region including the flower export technology, red gram transplanting technology, rice-fish-poultry and the pioneering work in agro forestry and millets and so on. There are also concerns like the decline in paddy cultivation in Kerala, primarily due to the high cost and shortage of labour. Both researchable and developmental issues are to be addressed in this context by the research and development departments to bring about a visible change in the agrarian sector.

Dr. K.D. Kokate, DDG, Extension highlighted the importance of the KVKs in technology dissemination and requested the Vice Chancellors to fill up the vacancies of the SMSs on a priority basis. It is also essential that the Scientific Advisory Committee meetings are held regularly and in time to carry out the KVK programmes as per mandate. Dr. Kokate particularly commended on the performance of the Kannur KVK in Kerala for its good performance. For effective functioning of KVKs district level technology interventions are required for which the necessary inputs have to come from the SAUs and the ICAR Institutes. Referring to the issue regarding biopesticide and bioinsecticide production by certain KVKs, Dr. Kokate suggested that the formalities regarding the registration of these products should be done by the SAUs and Research Institutes that developed these technologies.

The Chairman wound up the discussions, exhorting the research and development departments for concerted efforts to address the regional issues on a specific time frame. He suggested that state level meetings have to be organized under the leadership of the SAU

concerned along with the Secretaries and other state functionaries to discuss the problems and issues in the state. All the research establishments in the state including SAUs and ICAR institutes and centres should participate in these meetings for an effective dialogue on the research and extension needs of the state. He also stressed the need for interdepartmental linkages among the development departments viz., agriculture, horticulture, animal husbandry and fisheries, for the overall growth and integrated development of the region. It was suggested that the Universities and Institutes should have only few flagship projects to address key issues and not diffuse their resources and efforts on too many programmes. Institutes and SAUs should identify the programmes they will undertake and activities they will not. Focus should be more on research, which is the core assignment of the NARS. Once the core areas are identified, the partners are to be identified with complementing strengths for effective execution of the research programmes. This is the basis for the technology platforms proposed under the XII Plan.

The Chairman thanked all the participants for their effective participation in the deliberations.

Recommendations:

1. A Committee will be formed to look into the issues of Coconut wilt and Arecanut YLD and prepare a Status Report on the two diseases. Dr. G.V. Thomas, Director, CPCRI will be the coordinator for this Committee. (Dr. G.V. Thomas).
2. In Tamil Nadu, root wilt disease of coconut is spreading in 3 districts viz., Theni, Tirunelveli (Shengottai) and Kanyakumari. It is necessary to slow down the spread of the disease by developing a border belt as has been done in Kerala followed by removal of diseased palms. (CPCRI; Director of Horticulture, Tamil Nadu).
3. The research centres at Appangala, Sakleshpur and Mayiladumpara should jointly develop packages for cardamom. (IISR; PC Spices)
4. There is a need for further research on all aspects of production and value addition of minor millets. There is also an urgent need to enhance seed production in minor millets and greater need to popularize their use (SAUs; PC- Minor millets).
5. The Gene Bank information held by the TNAU may be made accessible so that the material could be shared by the SAUs / Institutes (TNAU).
6. When a variety is released, not only grain quality but straw quality/fodder value also has to be considered (SAUs; Institutes).
7. All the equipments developed by ICAR and SAUs may be tested and categorized and circulated among the KVKs (DDG, Engg).
8. Mechanism for certifying feed quality and safety to be evolved. This is becoming increasingly important in view of the high antibiotic and pesticide residue presence in feed and fodder (NIANP).
9. More attention is to be paid to the fishery sector of Lakshadweep. Marine fisheries management and post-harvest technology for Lakshadweep should be taken up by the Institutes concerned (CMFRI, CIFT)
10. PDADMAS should advice the State Governments on the likely disease occurrence and their management including frequency of vaccination and dosage and the monitoring aspects (PD ADMAS).
11. UAS, Raichur has developed the technology for red gram transplanting, which gives improved yields with reduced seed requirement. This technology may be given wide publicity so that more people will adopt this technology (UAS Raichur; ZPD).
12. Institutes and SAUs may carry out continuous monitoring to locate effective parasitoids and other biocontrol agents particularly in the context of new pests emerging across crops. (SAUs)
13. A small scale study may be initiated on Emu farming and on value addition on its products (TANUVAS).
14. The estrus synchronization protocols developed by CSWRI and TANUVAS may be compared for cost effectiveness and efficiency (TANUVAS; CSWRI).

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Annexure I

Area, production and yield of rice in different states of Region No. VIII
during 2005 - 06 to 2009 - 10

State	2005-06	2006-07	2007-08	2008-09	2009-10
Production in '000 tonnes					
Kerala	275.8	630.96	528.99	590	600
Karnataka	2740	3445.65	3661.88	3800	3690
Tamil Nadu	5220	6611.18	6034.01	5180	4400
Pondicherry	24.8	59.90	-	-	-
Total	8090.6	10116.73	10224.88	9570	8690
All India	91790	93360	96690	99182	89093
% of India	8.8	10.8	10.6	9.6	9.8
Productivity in kg/ha					
Kerala	2284	2390	2310	2519	2557
Karnataka	3868	2470	2625	2511	2482
Tamil Nadu	2546	3423	2817	2683	3070
Pondicherry	2465	2465	2618	2442	-
Total & Av.	2232.6	2149.6	2074	2031	2027.25
All India	2102	2131	2202	2178	2125
% of India	106.2	100.9	94.2	93.3	95.4
Area in '000 ha					
Kerala	275.8	264	229	230	230
Karnataka	1485	1395	1395	510	1490
Tamil Nadu	2050.5	1931.4	2142	1930	1850
Pondicherry	24.3	24.3	-	-	-
Total	3835.6	3614.7	3766	3670	3570
All India	43660	43810	43910	45540	41920
% of India	8.8	8.3	8.6	8.1	8.5

Annexure II

Area, production and yield of sorghum in different states of Region No. VIII
(Kharif & Rabi)

State / details	2006-07	2007-08	2008-09	2009-10
Karnataka				
Area ('000 ha)	1.41	1.38	1.38	1.37
Production ('000 t)	1.31	1.82	1.63	1.41
Yield (kg/ha)	924	1316	1179	1027
Tamil Nadu				
Area ('000 ha)	0.29	0.63	0.28	0.24
Production ('000 t)	0.29	0.39	0.44	0.22
Yield (kg/ha)	999	631	827	923

Annexure III

Area, production and productivity of major oilseed crops

State	Crop		2007-08	2008-09	2009-10	2010-11
Karnataka	Sunflower	A	10.26	10.01	7.94	4.10
		P	5.86	4.96	3.04	2.19
		Y	586	496	383	534
	Safflower	A	0.7	0.73	0.68	0.57
		P	0.57	0.58	0.50	0.41
		Y	814	795	735	719
	Soybean	A	1.13	1.99	2.31	2.17
		P	0.97	1.97	2.37	2.32
		Y	858	990	1025	1070
	Groundnut	A	9.08	8.16	8.18	8.59
		P	7.33	5.3	5.12	7.07
		Y	807	650	626	823
	Total Oilseeds	A	22.76	21.78	20.01	16.60
		P	15.49	12.12	10.05	12.12
		Y	681	556	563	730
Tamil Nadu	Sunflower	A	0.44	0.26	0.20	0.096
		P	0.70	0.34	0.27	0.143
		Y	1590	1329	1352	1486
	Groundnut	A	5.35	5.49	4.13	4.38
		P	10.48	9.75	8.90	10.73
		Y	1957	1950	2155	2396
	Total Oilseeds	A	6.59	5.85	4.95	5.37
		P	11.47	10.43	9.40	11.31
		Y	1739	1782	1898	2108
All India	Total Oilseeds	A	266.93	275.58	259.59	2682.4
		P	297.55	277.19	248.82	3110.0
		Y	1115	1106	959	1159

A= Area (lakh ha); P= Production (lakh tonnes); Y= Productivity (kg/ha)

Annexure IV

Area, production and productivity of major pulse crops

State	Crop		2007-08	2008-09	2009-10	2010-11
Karnataka	Pigeonpea	A	6.81	5.97	6.04	8.91
		P	4.85	3.15	2.82	5.09
		Y	712	528	467	571
	Chickpea	A	6.05	7.23	9.72	9.60
		P	3.67	4.01	5.74	6.01
		Y	607	552	591	626
	Urdbean	A	1.62	1.12	1.18	1.28
		P	0.66	2.9	0.14	0.45
		Y	407	259	119	352
	Mungbean	A	1.59	2.74	2.79	4.04
		P	0.74	0.37	0.47	1.11
		Y	240	135	168	275
	Total pulses	A	23.83	20.87	24.79	26.99
		P	12.65	9.72	11.18	14.97
		Y	531	466	451	555
Tamil Nadu	Pigeonpea	A	0.30	0.26	0.26	0.60
		P	0.21	0.18	0.20	0.38
		Y	701	677	765	629
	Urdbean	A	3.07	2.62	2.60	3.19
		P	0.74	0.78	0.99	1.27
		Y	240	301	380	398
	Mungbean	A	1.58	1.38	1.38	1.97
		P	0.48	0.31	0.48	0.72
		Y	302	227	344	365
	Total pulses	A	6.1	5.36	5.35	7.27
		P	1.85	1.65	2.04	2.95
		Y	303	307	382	407
All India	Total pulses	A	236.33	220.93	222.82	26.28
		P	147.62	145.67	146.62	18.09
		Y	625	659	630	689

A= Area (lakh ha);

P= Production (lakh tonnes);

Y= Productivity (kg/ha)

Annexure V

Area, production and productivity of sugarcane

State	Year	Area (lakh ha)	Production (lakh tonnes)	Productivity (t/ha)
Kerala	2006-07	5	440	88.0
	2007-08	2	218	109.0
	2008-09	2	276	125.0
	2009-10	3	285	95.0
	2010-11	2	190	95.0
Karnataka	2006-07	326	28670	87.9
	2007-08	306	26240	85.6
	2008-09	281	23328	83.0
	2009-10	337	30443	90.3
	2010-11	421	37595	89.3
Tamil Nadu	2006-07	391	41124	105.1
	2007-08	352	38071	107.6
	2008-09	309	32804	99.7
	2009-10	293	29746	101.4
	2010-11	336	34292	102.0
Pondicherry	2006-07	2	160	80
	2007-08	2	160	80
	2008-09	2	162	-
	2009-10	-	-	-
	2010-11	-	-	-

Annexure VI

Area, production and productivity of cotton

State	Year	Area (Lakh ha)	Production (Lakh bales)	Productivity (kg/ha)
Tamil Nadu	2007-08	0.99	4.00	687
	2008-09	1.09	5.00	780
	2009-10	1.04	5.00	817
	2010-11	1.22	5.00	697
	2011-12	1.21	5.00	702
Karnataka	2007-08	4.03	8.00	337
	2008-09	4.08	9.00	375
	2009-10	4.55	12.25	485
	2010-11	5.45	10.00	312
	2011-12	5.49	12.00	372

Source: Cotton Advisory Board dated 24-1-2012

Annexure VII

Area, production and productivity of tobacco

Karnataka	FCV Tobacco	Year	Area (ha)	Production (tonnes)	Productivity (kg/ha)
		2007-08	85,760	87620	1022
		2008-09	90,175	113990	1264
		2009-10	1,06,000	115660	1091
		2010-11	1,17,924	127850	1084
		2011-12	1,06,000	79000	-
	Bidi tobacco	2007-08	25203	20716	822
		2008-09	21068	16665	791*
		2009-10	23649	16531	699
		2010-11	16572	15611	942-
		2011-12	13378	10034	750 [#]
Tamil Nadu	Chewing Tobacco	2007-08	0.160	0.384	2,400
		2008-09	0.150	0.367	2,450
		2009-10	0.175	0.437	2,500
		2010-11	0.170	0.433	2,550
		2011-12	0.160	0.400	2,500
	Country Cheroot Tobacco	2007-08	0.019	0.029	1,550
		2008-09	0.018	0.028	1,600
		2009-10	0.020	0.032	1,600
		2010-11	0.020	0.033	1,650
		2011-12	0.018	0.028	1,600

* Low yields due to heavy rains in short span of time at growth stage

Moisture stress at growth stage

Annexure VIII

Commercial Crops - Research support in the Region

(a) Central Institutes:

1. Sugarcane Breeding Institute, Coimbatore (Tamil Nadu)
2. Research centre of Sugarcane Breeding Institute, Kannur (Kerala)
3. Regional Station of Central Institute for Cotton Research, Coimbatore (Tamil Nadu)
4. Regional Station of Central Tobacco Research Institute, Hunsur (Karnataka)
5. Regional Station of Central Tobacco Research Institute, Vedsandur (Tamil Nadu)

(b) Co-ordinated Project Centres /Network Centres:

Crop	Location	Instt. / University	State
Sugarcane	Thiruvalla	KAU, Thiruvalla	Kerala
	Mandya	UAS, Bangalore	Karnataka
	Sankeshwar	UAS, Dharwad	Karnataka
	Cuddalore	TNAU, Coimbatore	Tamil Nadu
Cotton	Main Centres:		
	Coimbatore	TNAU, , Coimbatore	Tamil Nadu
	Dharwad	UAS, Dharwad	Karnataka
	Sub Centres:		
	Siruguppa	UAS, Raichur	Karnataka
	Srivilliputhur	TNAU, Coimbatore	Tamil Nadu
	Voluntary Centres:		
	ARS, Aruppukottai		Tamil Nadu
	ARS, Kovilpatty		Tamil Nadu
	CRS, Veppanthattai		Tamil Nadu
	UAS, Raichur		Karnataka
	ARS, Bheemarayangudi		Karnataka
	ARS, Hagari		Karnataka
	ARS, Arabhavi		Karnataka
	ARS, Annigere		Karnataka
	PAJANCOARI, Karaikal		Puducherry
Tobacco	Shimoga	UAS, Bangalore	Karnataka
	Nipani	UAS, Dharwad	Karnataka



A view of the participants in the Inaugural Session

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